Annual Report

OF THE

AMERICAN INSTITUTE

OF  THE

City of New York

FOR THE YEARS

1868 & 9.

Albany

The Argus Co., Printers.

1869.

TWENTY-NINTH ANNUAL REPORT

OF THE

AMERICAN INSTITUTE,

OF THE

CITY OF NEW YORK,

FOR THE

Year 1868-9.

ALBANY:
THE ARGUS COMPANY, PRINTERS.
1869.

STATE OF NEW YORK.

No. 211.

IN ASSEMBLY,

April 18, 1869.

TRANSACTIONS OF THE AMERICAN INSTITUTE.

American Institute,
New York, *April* 12*th*, 1869.

To the Hon. Truman G. Younglove,

Speaker of the Assembly of the State of New York:

Sir—I transmit herewith the Annual Report of the American Institute of the city of New York, for the year ending in April, 1869.

I have the honor to remain, very respectfully,

Your obedient servant,

SAMUEL D. TILLMAN,

Corresponding Secretary.

AMERICAN INSTITUTE.

OFFICERS AND COMMITTEES—1869.

TRUSTEES.

PRESIDENT,

HORACE GREELEY.

VICE-PRESIDENTS,

DUDLEY S. GREGORY,
CHARLES P. DALY,
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ORESTES CLEVELAND,
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THOMAS RUTTER,
SAMUEL R. WELLS,
EDWARD RICHMOND,
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J. TRUMBULL SMITH,
J. V. C. SMITH.
JOSEPH B. LYMAN,
WALTER SHRIVER.

COMMITTEES.

Admission of Members—Charles E. Burd, James H. Drake, John W. Chambers, J. Owen Rouse, Stephen R. Krom.

Finance—Thomas M. Adriance, Thomas Williams, Jr., Charles Chamberlain, Simeon Baldwin, J. De Lamater.

Library—James K. Campbell, William Hibbard, Dubois D. Parmelee, Hamilton E. Towle, George Frederick Houghton.

Repository—Lewis Feuchtwanger, Albro Howell, Nathaniel Wheeler, Frank A. Butler, H. J. Newton.

Manufactures and Machinery—Miers Coryell, Hamilton E. Towle, Thomas D. Stetson, Charles E. Emery, Walter Shriver.

Chemistry, Mineralogy and Geology — Charles F. Chandler, Dubois D. Parmelee, Julius G. Pohle, J. S. Newberry, John W. Morgan.

Optical Science—John B. Rich, John Frey, L. Bradley, Samuel Jackson, P. H. Vanderweyde.

Civil Engineering and Architecture—William J. McAlpine, Robert G. Hatfield, Leopold Eidlitz, Samuel McElroy, Edward S. Renwick.

Committee on Agriculture—Nathan C. Ely, John Crane, P. T. Quinn, S. Edwards Todd, Josiah H. Macy.

Horticulture—William S. Carpenter, Benj. C. Townsend, John Henderson, Isaac Buchanan, James Hogg.

Commerce—E. G. Squier, Edmund Dwight, J. V. C. Smith, James H. Sackett, John H. Macy.

REGENTS OF THE AMERICAN INSTITUTE.

EDWIN D. MORGAN, SAMUEL F. B. MORSE,
GERRIT SMITH, HAMILTON FISH,
CORNELIUS VANDERBILT, HENRY W. BELLOWS,
EZRA CORNELL, HENRY WARD BEECHER,
ABIEL A. LOW, WILLIAM H. APPLETON,
DENNING DUER, ORLANDO B. POTTER,
JOHN A. GRISWOLD.

REGENTS EX-OFFICIO.

THE GOVERNOR OF THE STATE OF NEW YORK.
THE MAYOR OF THE CITY OF NEW YORK.
THE U. S. SECRETARY OF THE INTERIOR.
THE TRUSTEES OF THE AMERICAN INSTITUTE.

FACULTY.

SAMUEL DYER TILLMAN, LL. D., Professor of Mechanical Philosophy and Technology.

JULIUS G. POHLE, M. D., Professor of Analytical Chemistry.

ROBERT P. STEVENS, M. D., Professor of Geology and Mineralogy.

OFFICERS.

JOHN W. CHAMBERS, Clerk and Librarian.
MORTIMER W. THOMPSON, Messenger.

COMMUNICATIONS TO THE LEGISLATURE.

To the Honorable the Legislature of the State of New York:

The undersigned, Trustees of the American Institute of the city of New York, respectfully submit, as a report of its transactions for the year ending in April, 1869, the annexed documents, containing:

I. A Review of the Operations of the Institute, presented by the Board of Trustees at the Annual Meeting held on the 4th day of February, 1869.

II. An Exhibit of the Receipts and Expenditures during the year.

III. The Annual Reports of the several Standing Committees of the Institute.

IV. Twelve Scientific Lectures, delivered at Steinway Hall, in the city of New York, under the auspices of the American Institute.

V. The Transactions of the Farmers' Club, including communications from residents of other States.

VI. The Proceedings of the Polytechnic Association, embracing notes on progress in Science and Art, both at home and abroad.

VII. The discussions of the Photographical Section of the American Institute.

HORACE GREELEY, *President.*
D. S. GREGORY,
CHAS. P. DALY,
CYRUS H. LOUTREL,
GEO. PEYTON,
SAML. D. TILLMAN,
S. R. COMSTOCK.

NEW YORK, *April* 12*th*, 1869.

ANNUAL REPORT OF THE BOARD OF TRUSTEES.

In presenting their annual report the trustees would first respectfully direct attention to the financial condition of the Institute. During the past year its income has largely exceeded its expenditures, and $10,000 of the surplus have been invested in government bonds. For a full statement of its accounts, reference is made to the exhibit of the finance committee. The real estate on Broadway and Leonard street, which is its principal source of income, was again leased to the 1st of May, 1869, at the rate of $20,000 per annum. No purchaser has yet been found for this property at the price fixed upon by the Institute, although that price is regarded by many as below its present value. The interests of the Institute now require that its funds should be made more available, in anticipation of the early purchase of lots and the erection of a building for its own occupation, and the board would suggest that the Institute should take further action in the premises. It is a subject of congratulation that the various organizations under the control of the Institute have never been more energetic and efficient than at present. The meetings of the Farmers' Club, during the past year, have been large, and the communications it has received from all parts of the country have added much to the interest of its proceedings. These are reported in the semi-weekly and weekly editions of the leading journals of the city, and, as they are read by not less than a million of persons, it is not too much to say that the American Institute, through its Farmers' Club alone, exerts a wider influence than any other society ever formed for the diffusion of useful knowledge. The Polytechnic Association continues to be an efficient auxiliary of the Institute. It has discussed, in the presence of large audiences, questions relating to mechanics, chemistry, mining and engineering; examined many new inventions and furnished regular reports on the general progress of science.

The Photographical Section has held monthly meetings, which have been attended by some of the leading practical and amateur photo-

graphers. Its proceedings have been of too technical a character to interest any but those who understand something of the chemical action of light, yet they contain much of interest to the large class who are now practising the most beautiful of all modern arts.

The proceedings of the several societies mentioned, and a very full report of the exhibition of 1867, form the bulk of the volume of Transactions, soon to be issued by the State printer, which is by far the largest of our series. Under authority conferred by the by-laws, the Board of Trustees inaugurated, in November last, a course of scientific lectures, which have been continued weekly since that time, and will close on the 10th day of February; the day preceding the annual election of officers. It was deemed best to introduce in this course a great variety of topics, and to engage as lecturers scientists of established reputation, and mostly from our leading institutions of learning. The project excited unusual public interest, and was warmly approbated by the press. These lectures have been the means of bringing the American Institute more directly to notice of a large class of citizens who formerly knew little of its operations; they have also brought together many members with their families, who seldom visit the rooms of the Institute. The steadily increasing attendance throughout the course is the best evidence of its popularity; and its success is more marked from the fact that no extended series of lectures of a similar character have before met with public approval. It has demonstrated that science, when expounded by competent teachers, and illustrated with experiments and attractive diagrams, will command attention, and cannot fail to exert a beneficent influence. The Board of Trustees, therefore, recommend that the system now inaugurated be continued from year to year.

For reasons set forth in the report of the Board of Managers, no general exhibition was held in the fall of 1868. So long as the Institute depends on securing the temporary occupation of premises there must necessarily be some uncertainty as to the holding of an autumnal exhibition. This uncertainty naturally influences the action of those manufacturers and producers who are desirous of competing for premiums, but who seldom make any preparation therefor until they receive our circular, announcing the holding of our exhibition, which, as a general rule, is not issued more than two months in advance. All the annoyances and vexations arising from the spasmodic action of the Institute in its preparations for an exposition are so thoroughly appreciated by its members, that it is believed they

will heartily co-operate in any scheme which will secure for it a permanent structure commensurate with its wants.

The holding of an exhibition during the coming fall has been determined earlier than usual by the action of the Institute, in relation to the correspondence between the President of the National Association of Wool Manufacturers and the President of the American Institute. A proposition from that Association for a joint exposition of wool industry, under the auspices of the American Institute having been accepted, the Executive Committee of that Association have already circulated 2,000 blank applications for space, with a request that each manufacturer should specify as minutely as possible, the character and varieties of goods and articles to be exhibited; and with respect to machinery, the amount of space to be occupied by each machine. The circular states that it is highly important that returns should be transmitted before February 1st, 1869, to John L. Hayes, Esq., of Boston, Secretary of the Executive Committee, that the Institute may have information of the space required for the exposition, as arrangements for building must be made in February. From the prompt action of the Executive Committee, it is inferred that the National Association of Wool Manufacturers will make a very large display, and it is highly important that measures be early taken by the managers to be elected on the 11th day of February, in relation to providing suitable buildings for the next general exhibition, which promises to be much larger than any yet held.

The reports of the standing committees to be presented at this meeting, will show the faithful manner in which their several duties have been performed. Valuable additions have been made to the library; and of late, there have been large accessions to the list of members. On reviewing the operations of the year, the trustees find abundant cause for congratulation, and they hope its members will be reassured that the Institute is steadily progressing in power and usefulness.

HORACE GREELEY,
DUDLEY S. GREGORY,
ORLANDO B. POTTER,
CHARLES P. DALY,
SAMUEL D. TILLMAN,
SYLVESTER R. COMSTOCK,
Trustees.

New York, *February* 4, 1869.

REPORTS OF COMMITTEES.

FINANCE.

Receipts and disbursements of the American Institute of the City of New York, for the year ending Januarg 31st, 1869.

Balance in the treasury January 31, 1868.............		$5,540 08

RECEIPTS.

Rental of property.....................	$20,000 00	
Admission fees, dues, and from life members,	2,856 00	
From managers of 37th annual fair.......	215 96	
State appropriation of 1867..............	1,187 50	
Interest on investments..................	429 78	
Miscellaneous sources	122 74	
		24,811 98
		$30,352 06

DISBURSEMENTS.

Taxes, assessment, and insurance on property	$3,590 59	
Repairs on property....................	152 78	
Books, periodicals, and binding	695 38	
Book cases and furniture for library and rooms	576 16	
Rent at Cooper Union and gas light......	2,011 53	
Bills for the 37th annual fair	542 15	
Printing and stationery.................	491 39	
Reporting for Polytechnic and Photographical sections	107 00	
Freight and expenses—Transactions from Albany...........................	99 30	
On account of course of scientific lectures..	1,513 50	
Salaries............................	4,229 66	
Carried forward	$14,009 44	$30,352 06

Brought forward....................	$14,009 44	$30,352 06
New frame, portrait of ex-President Tallmadge..............................	28 00	
Newspapers, advertising, postage, and incidental expenses......................	697 45	
	$14,734 89	
Invested in United States bonds..........	10,612 50	
		25,347 39
Balance in bank January 31, 1869................		$5,004 67

THOMAS M. ADRIANCE,
THOMAS WILLIAMS, Jr.,
CYRUS H. LOUTREL,
CHARLES CHAMBERLAIN,
SIMEON BALDWIN,
Finance Committee.

AGRICULTURE.

In making this, our annual report, we have to say that our duties have been confined to the transactions of the Farmer's Club, which we have great satisfaction in stating, is extending its benefits and its usefulness to nearly every State and Territory, and even its beneficial influence is acknowledged in Europe by agriculturists, who have highly complimented it. During the year the meetings of the club have been crowded with an intelligent audience of those interested in the subject of agriculture, fruit growing, inventors of agricultural implements and manufacturers of newly invented and useful articles, connected with this branch of industry. Many committees have been appointed by the Farmer's Club, who have visited several places in other States as well as places in this State, to examine and inquire into the mode of culture, the product of crops under different modes of cultivation, quality, quantity and expense of producing; and also to see the practical working of many newly invented agricultural implements. These important duties have been discharged by the committees, without incurring any expense to the American Institute.

As an indication of the importance which is attached to the proceedings of the Farmer's Club by the public, we find nearly all of

the daily and weekly newspapers of the city, and some of other States, represented at every meeting, who take notes and publish at great length our proceedings. And many of the most active and valuable members of the Farmer's Club, are connected with the various newspapers and other weekly publications, who devote a large amount of time for the benefit of the club, which we hope and believe they find helps them as well.

To Mr. James A. Whitney, of the "Artizan," we are under special obligations, for his analysis of soils (to ascertain their fertilizing qualities) and other scientific investigations gratuitously made. As the proceedings of the club when published, will be furnished every member of the American Institute, we see no necessity for extending this report.

Respectfully submitted.

NATHAN C. ELY,
S. EDWARDS TODD,
P. T. QUINN,
JOHN CRANE,
JOSIAH H. MACY,
Committee.

New York, *Feb.* 1, 1869.

MANUFACTURES AND MACHINERY.

The committee on manufactures and machinery for 1868–9 respectfully report:

That but few inventions have been referred to them during the past year by the Institute, and they have been more than ever impressed with the wisdom of the conclusion, long since arrived at, that it is inexpedient for your committee to express opinions on mechanical questions except when especially directed so to do. A degree of importance is attached to any report from a standing committee of the American Institute, and none should be made unless its members have ample time and opportunity for a complete investigation. While we would aid the efforts of inventors to attract attention to their inventions through the Institute, and through an open discussion of their merits and defects, such as is afforded by the Polytechnic Association, and would give them the privilege of securing the attendance of zealous friends to put their inventions forward in such discussions, we look with disfavor on any efforts to secure favorable reports from any committee of the Institute in their official capacity. Thus believing, we have not submitted a report on any

of the inventions which have been brought to our notice during the year, which, however, would have been done had your committee found any decidedly novel and commendable feature that seemed of sufficient importance.

Your committee have little of importance to communicate, further than the increase and heretofore unprecedented success of the weekly meetings of the Polytechnic Association, for the conduct of which your committee is responsible. It organized the society for the year by reappointing Prof. S. D. Tillman as chairman, and selecting C. E. Emery to fill the place of the former secretary, who is still in Europe.

The interest of its meetings has been largely due to the faithful and regular attendance of a few members of the Institute, and to the zeal and discretion of the chairman, who has presided with impartiality, and endeavored to give ample opportunities to all who have desired to present before the association new inventions and new thoughts on mechanical and chemical subjects.

The society has devoted a number of evenings to the discussion of the best means of rapid transit through the city of New York, in which the advantages and disadvantages of tunnels, deep cuts, elevated railways and railways on the street level were very fully set forth. It has also given great consideration to the question of uniting the cities of Brooklyn and New York by means of bridges, causeways and tunnels. Many other questions of general interest have been discussed and many new inventions examined.

A prominent feature of the Polytechnic has been the usual summary of foreign scientific news presented by the chairman, which has afforded topics for many interesting debates.

THOMAS D. STETSON,
HAMILTON E. TOWLE,
MIERS CORYELL,
CHARLES E. EMERY.

New York, *February* 3, 1869.

ADMISSION OF MEMBERS.

The Committee on the Admission of Members beg leave to submit the following report:

The committee have held ten meetings during the past year, and have made reports at each monthly meeting of the Institute, giving the names, occupations and residences of the candidates, and by whom proposed.

During the year 199 candidates have been reported on and admitted as members.

The course of scientific lectures has created quite an interest among persons of a scientific character, and has caused quite a large number to join the Institute; at the monthly meetings, held in December and January last, 103 persons were reported on and admitted as members.

The great increase of members admitted during the past three or four years seems to have infused new life into the Institute, and is just what the Institute needs to enable it to keep its advanced position among the institutions of the country.

The members admitted during the year are as follows:

March	23
April	11
May	6
June	7
September	19
October	8
November	12
December	63
January	40
February	10
Total	199

The following is the number of members belonging to the Institute:

Honorary members		85
Corresponding members		248
Life members	1,255	
Less deceased	233	
		1,022
Annual members		1,221
Total		2,576

All of which is respectfully submitted.

CHARLES E. BURD,
JAMES H. DRAKE,
JOHN W. CHAMBERS,
JOHN F. COREY,
J. OWEN ROUSE,
Committee.

New York, *February* 4, 1869.

COMMITTEE ON LIBRARY.

The time has again arrived, when according to the provisions of the by-laws of the American Institute, the library committee are required to make a report. They beg leave to submit the following:

By the authority of the Institute given them at the last annual meeting, they have had nine additional book cases erected, at an expense of $418,38. These additions have not only improved the appearance of the rooms, but have given the librarian an opportunity to make a better classification of the books.

Although the financial condition of the country has not relieved us from the necessity of paying high prices for books, especially foreign works, your committee have nevertheless felt it to be their duty to purchase whatever works seemed to be demanded, in order to accomplish the grand object of the Institution. The committee have accordingly procured some of the best works on various branches of science.

The committee, during the past year, have been enabled to complete several important sets of scientific journals, among them the London Mechanic's Magazine, eleven volumes; and the Journal of the Royal Agricultural Society, nine volumes.

The purchases during the year have been confined to works of a scientific character. The committee have expended for books and periodicals $583.71, and for binding $111.67, making a total of $695.38.

The whole number of volumes in the library at the date of the last report, was		9,115
Added during the year by purchase	140	
Donations as exchanges	168	
		308
Making the total number of volumes now in the library.		9,423

Nearly all of which are in excellent condition.

The committee cannot close this report without alluding to the valuable donation of 149 volumes of scientific works made to the Institute by Mr. James S. Thomas. This donation was reported to the Institute at the December meeting, when Mr. Thomas was unanimously elected a life member.

A list of donations of books to the library during the year will be found annexed.

The committee respectfully ask the Institute for an appropriation of $500 to be placed at their disposal.

All of which is respecfully submitted.

JAMES K. CAMPBELL,
WILLIAM HUBBARD,
DUBOIS D. PARMELEE,
S. D. TILLMAN,
Committee on the Library.

New York, *February 3d*, 1869.

REPORT OF THE BOARD OF MANAGERS.

The Board of Managers respectfully report that immediately after its organization, the board took into consideration the question of holding an autumnal exhibition. Nearly all its members were also members of the preceding board, which had the management of the most successful exhibition ever given by the Institute; and they were, as a natural consequence, very desirous that the proposed display should equal, if not exceed, that of 1867. Their experience had convinced them of the importance of having a few very prominent objects of attraction, as well as a complete assortment in its several departments, to secure its pecuniary success. Although no very striking novelties had recently been brought to notice, and no very strong feeling manifested among the leading manufacturers of the country in favor of a fair, still the board decided to take the preliminary steps to secure the use of suitable grounds and buildings for that purpose. Great inconvenience had been experienced at the exhibition of 1867, from a want of room for the proper display of articles and the working of machines; and the first aim of the board was to provide premises more capacious than had been used since the Institute had occupied the crystal palace.

The board was not successful in finding such a locality, and being convinced that the accommodation of a complete exposition required the erection of a temporary structure, it decided to refer the subject to the trustees of the Institute, and make the holding of an exhibition conditional upon their providing the necessary buildings. The trustees did not recommend the erection of an exhibition building, and had they done so, it is doubtful whether such a building, constructed in the cheapest manner, could have been completed in time to be occupied at the usual day for opening our autumnal display.

The history of the past year only makes more apparent the absolute necessity of immediately building a structure for the accommodation of all the departments of the American Institute, and more especially, its general exhibitions. All past experience shows that the fine spirit and energy evinced by every new Board of Managers,

have been generally exhausted in endeavors to procure suitable quarters, preparing them for occupancy, introducing motive power, making its proper connections with machinery, and constructing various devices for the accommodation of exhibitors and visitors, which at the end of six weeks are nearly worthless. The difference between the amount paid for material and labor in preparing for the exhibition, and the amount received for such material sold at its close, or in other words the loss resulting from these temporary preparations, has generally been large enough to equal the interest on the cost of an exhibition building, without including the value of the land which such a structure would occupy.

The Board of Managers would, therefore, in conclusion direct the attention of the Institute to the importance of making permanent provisions for its annual expositions.

ORESTES CLEVELAND,	GEO. PEYTON,
JAMES KNIGHT,	WM. H. BUTLER,
NATHAN C. ELY,	GEO. SIMPSON,
GEO. FRANCIS DAWSON,	CHAS. K. HAWKES,
HENRY J. NEWTON,	EDWARD RICHMOND,
J. GROSHON HERRIOT,	SAMUEL D. TILLMAN.

NEW YORK, *February* 4, 1869.

SPECIAL REPORT FROM THE TRUSTEES.

The Board of Trustees respectfully report: That in accordance with a resolution adopted by the Institute, and by virtue of the 25th article of the by-laws, the Board made all the preliminary arrangements for a course of scientific lectures to be delivered once a week for three months, and published the following programme:

SCIENTIFIC LECTURES

BEFORE THE

AMERICAN INSTITUTE,

AT STEINWAY HALL, FOURTEENTH STREET.

The Trustees have the pleasure of announcing that they have secured the services of twelve distinguished Scientists for the coming Course of Lectures, which promises to be one of unsurpassed value and interest.

Wednesday, Nov. 25, 1868—By Prest. Barnard, Columbia College, N. Y.; "On the Microscope and its Revelations."

Friday, Dec. 4—Prof. Alexander, College of New Jersey, Princeton; "On the Telescope."

Friday, Dec. 11—Prof. Guyot, College of New Jersey, Princeton; "On the Barometer."

Wednesday, Dec. 16—Prof. Silliman, Yale College, New Haven, Conn.; "On the Philosophy of the Tea Kettle."

Wednesday, Dec. 23—President Dawson, of McGill College, Montreal; "On the Primeval Flora."

Wednesday, Dec. 30—Mr. James Hall, State Geologist, Albany; "On the Evolution of the North American Continent."

Wednesday, Jan. 6, 1869—Prof. Horsford, Cambrige, Mass.; "On the Philosophy of the Oven."

Wednesday, Jan. 13—Dr. T. Sterry Hunt, Montreal, Canada; "On Primeval Chemistry."

Friday, Jan. 22—Prof. Doremus, College of the City of New York; "On the Photometer."

Wednesday, Jan. 27—Mr. Waterhouse Hawkins, of London; "On Comparative Zoology."

Wednesday, Feb. 3—Prof. Cooke, Harvard College, Mass.; "On the Spectroscope."

Wednesday, Feb. 10—Wm. J. McAlpine, President American Society of C. E.; "On Modern Engineering."

Doors open at 7½ o'clock, P. M. After a prelude on the Organ, each Lecture will commence at 8.

TICKETS 50 CENTS EACH. NO RESERVED SEATS.

☞ Members' Tickets may be obtained at American Institute Rooms, No. 22 Cooper Union.

This programme was carried out to the letter. Each lecturer appeared at the hour advertised, and was warmly greeted by a large and intelligent audience. The diversity of the topics discussed, and the reputation of the speakers, awakened unusual interest in this course which seemed unabated to the close, when a series of resolutions were adopted by the audience approving of the whole plan, and requesting the publication of a full report of the twelve lectures in book form.

As the Course was chiefly intended for the benefit of the members of the Institute, it was deemed inexpedient to sell any reserved seats to non-members; this decision made it proper to open the doors of the lecture room at an early hour, and to provide music for the entertainment of those who secured good seats by prompt attendance. Another item not included in the original estimate of the expense of the Course, was the cost of providing for suitable experiments and drawings for the better illustration of the lecture. These expenses would have been much less if the Institute had apparatus of its own for use on such occasions.

The total expense incurred for the course is as follows:

Twelve lecturers at $100 each	$1,200 00
Illustrations and experiments	774 50
Rent of Steinway Hall at $75 per night	900 00
Organist at $15 per night	180 00
Printing and bill posting	83 25
Advertising	298 11
Ticket seller, door keepers and assistants	120 00
	$3,555 86
Less amount received from sale of tickets to non members	1,265 00
Leaving the amount to be paid by the Institute	$2,290 86

From this statement it will be seen that the expenditure, over and above the receipts, is about $200 less than the amount already appropriated for this object.

Aside from the benefit which members have derived from this course of scientific lectures, it may safely be asserted that no step has recently been taken by the Institute which is more likely to be followed by similar organizations. In this and neighboring cities societies are already preparing to inaugurate a system of scientific lectures during the next winter; and letters have been received from various quarters asking for the particulars of our plan.

On the whole, the Trustees are led to the conclusion that no expenditure of money by the Institute has been productive of more good in the diffusion of scientific knowledge than that incurred in this course of scientific lectures; and, from their experience, they feel confident that the system can hereafter be so modified and improved as to increase the attractions so much that the principal items of cost in a course will be paid by those attendants who are not members of the Institute.

The Trustees further report that they have accepted the proposition of the present tenants of No. 351 Broadway, belonging to the Institute, to pay $17,000 for these premises for one year from May 1, 1869.

The premises now occupied by the Institute in the Cooper Union building have been leased for another year at the sum of $2,175 per annum.

Respectfully submitted.

HORACE GREELEY,
DUDLEY S. GREGORY,
CHAS. P. DALY,
CYRUS H. LOUTREL,
S. D. TILLMAN,
GEO. PEYTON,
SYLVESTER R. COMSTOCK,
Trustees.

March 4th, 1869.

SCIENTIFIC LECTURE.—I.

THE MICROSCOPE AND ITS REVELATIONS.

BY REV. F. A. P. BARNARD, LL. D.

The first of the series of Scientific Lectures announced to be given before the American Institute this winter, was delivered by President Barnard, of Columbia College, at Steinway Hall on the evening of November 25th, 1868, to a large and intelligent audience. George W. Morgan presided at the organ. The lecture, entitled The Microscope and its Revelations, was listened to with great attention. The exhibitions showing the wonderful powers of the microscope by means of calcium lights, screens and magic lanterns were well worthy of the applause they received. The Hon. Horace Greeley, President of the American Institute, introduced the speaker by saying that the people of a great Emporium who went nightly to the Grande Duchess, Humpty Dumpty, and other amusements, came there that evening to be instructed as well as entertained by a lecture on the microscope and its revelations. Mr. Greeley then presented the lecturer, who was most cordially welcomed. President Barnard spoke as follows:

LADIES AND GENTLEMEN: I propose to occupy your attention for an hour this evening with some account of the construction and uses of an instrument which presents one of the most felicitous illustrations known of the ingenious application of theoretic principles to the production of a practical result, and which is in itself, at the same time, one of the most signal triumphs of the refined artistic skill of modern times in responding to the demands of science. Without any reference to the purposes for which it is intended, the microscope is a study of extraordinary interest. Whoever thoroughly understands its principles, must, at the same, become familiar with the essential laws of the most beautiful of the physical sciences, and with the properties of the marvelous medium through which we

acquire almost all the knowledge we possess of the material objects by which we are surrounded. And as it is by taking advantage of these properties that the instrument is made to accomplish the object proposed in its construction, so it is out of these properties themselves that the difficulties arise which embarrass its construction, and which have made its progress toward its present high degree of perfection laborious and slow.

But it is not as an illustration of optical science, or as an example of the ingenious adaptation of means to ends, or as a proof of the exquisite perfection of mechanical art in our time, that the microscope is principally interesting. If this were so, we should have no microscope at the present worthy of the name. Beautiful as is the instrument itself, and surprising as is the insight it gives us into a world imperceptible to ordinary vision, it would never have enlisted in the effort for its improvement the persevering labors of so many able men or accomplished artists but for the fact that its perfection was sought for not as an end, but as a means. In the study of the works of nature, it is but a narrow range which our unassisted senses enable us to grasp. If we look abroad from our planet into space, there is not one of the brilliant objects which stud the heavens, of which the information furnished by simple vision enables us to form the slightest conception. Their dimensions, their motions, their distances, the features of their surfaces, their enveloping atmospheres all these things are matters of which our natural powers permit us to discover nothing whatever. It is not, therefore, by any means surprising that, in an age when the telescope had not been dreamed of, the sky should have been taken for a transparent vault, and the heavenly bodies should have been supposed to be attached to its surface, like gems set in a crystal goblet. In like manner, if we attempt to survey objects of considerable dimensions on the earth's surface, we reach very shortly the limit of our powers. Though we discern the general outline of a mountain, we gather very little of the detail of its form or its structure. Of an extended lake or valley, the sight tells us still less. And, though this is the most perfect of all our senses, we very soon find that a principal condition of its usefulness is that its objects shall be of moderate dimensions and near at hand.

But even when this condition is realized, and objects are placed immediately before us in the most advantageous light and under the most favorable circumstances, we presently discover that there are

limitations to the information which sight can give which are very soon reached. In the examination of structure, in the study of form, in the observation of the movements and changes continually going on in organic things, we presently arrive at a point at which further progress is arrested by the imperfection of our powers. More than this; while thus vainly seeking to know something of the minute organization of bodies large enough to be seen and examined in mass, without difficulty, we make the new discovery that there exist many objects of a high order of interest which, in their fully developed proportions never attain a magnitude sufficient to betray even their existence to ordinary vision, and of which, without artificial helps, we could never know anything at all. And yet, it can easily be made to appear that on the knowledge which we may be able to attain of this class of objects must depend to a great degree the progress which is to be made in future toward the amelioration of the condition of the human race. Sanitary science, so far as there is such a science, rests at present upon principles to a great extent empirical. It is becoming every day more and more clear that the causes of all zymotic diseases are to be sought in excessively minute and widely scattered organisms, which to ordinary observation are totally imperceptible. This, it may be further remarked, is just as true of the diseases of plants as those of animals. The potato rot, the cotton rust, the smut of wheat, and the wasting of the vine, are just as certainly the product of microscopic fungi as the rinderpest, the epidemic among silk-worms, or the cholera among men.

To the study of objects of this kind, the microscope is absolutely indispensable. It is to the microscope, indeed, that we owe the knowledge that any such things exist. But supposing us to have been otherwise possessed of so much knowledge, it is still true that without this instrument we could know nothing beyond. We could know nothing of their modes of development, the conditions favorable to their multiplication, the manner of their diffusion, or the means best adapted to prevent their appearance or check their growth. This signal example of the use of the microscope I mention first, because of the magnitude of its importance, and because of the recency of its recognition. The application of the instrument to the study of disease generally, and especially to morbid anatomy, has long been familiar. So large are the services which it has thus rendered to the healing art, that, in the words of an eminent writer on this subject, "The smallest portion of a diseased structure

placed under a microscope, will tell more in one minute to the experienced eye, than could be ascertained by long examination of the mass of disease in the ordinary method."

To the progress of knowledge in animal and vegetable physiology, the microscope has made invaluable contributions. It has made it possible to detect nature in the very act of those transformations which are concerned in the development and growth of the living organism. It has demonstrated that all forms of organic life, however complicated, originate in the same simple form, the primordial cell, and are built up only by the multiplication and aggregation of cells essentially similar, however apparently differing. It has demonstrated, also, that every complex organism, however it may possess an aggregate individuality, has nevertheless a multiple and complex life, each cell in the aggregate mass being gifted with an independent and distinct life of its own. It has revealed the existence of vast groups of organisms, vegetable and animal, which never attain a higher level than that of the single cell, yet which swarm in all the waters of the earth, and have, in time past, existed in so prodigious numbers, that their fossil remains at this time form, to the almost complete exclusion of every other material, the substance of great geological deposits, hundreds of feet in depth, and thousands of square miles in horizontal extent. It has revealed in these organisms a degree of varied beauty and symmetry such as is not surpassed anywhere among the more conspicuous of the works of nature. The exquisite patterns sculptured over the surfaces of the silicious shells by which a large class of these minute objects are protected, rival the most ingenious figures executed by the engine lathe. And the elegant forms and graceful movements of others, which seem to be endowed with vital powers of a higher order; forms and movements which have no analogies in the world of life with which we are ordinarily conversant, provide perpetual food for new admiration and new surprise. These things furnish to the observer who comes to the study prepossessed with the idea that the creation, in all its greatest and minutest parts, has been called into being with exclusive reference to the exigencies of the human race, and with no other end but to subserve the uses or to minister to the enjoyments of man, material for profound reflection. And the pride of self-sufficiency with which he has been accustomed to regard himself as the great end of the material universe, cannot fail to receive, from the contemplation of these marvelously fashioned and wonderfully lovely forms

of invisible life, a severer shock than is felt even when he learns through the telescope how paltry a position the great earth itself, which he inhabits, occupies in the boundless universe of which it is an insignificant member. From both these widely opposite revelations he learns his own comparative unimportance, and both at the same time almost equally awaken within him the highest emotions of admiration and wonder of which he is capable. But, if, in view of the grandeur of the vast celestial universe, he is oppressed and stupified with a sense of the sublime, which is wanting when he turns his attention to the infinitely minute, there is no doubt that the feeling of simple *wonder* which these last discoveries awaken exceeds immeasurably anything which is excited by even the grandest of the truths which astronomy discloses. And the reason is sufficiently obvious. If the objects of astronomy are vast, the space they occupy is vaster still. It is difficult to lift our conceptions to a level with their grandeur, but not difficult to conceive that, however stupendous may be their dimensions, their existence is still possible and that in the region where they exist there is room enough for them and to spare. When, on the other hand, we discover in the infinitely small organizations exhibiting the highest degree of complexity, possessing the largest freedom of motion, exhibiting the most marvelously varied forms, and existing in numbers to defy computation, our astonishment is not so much an astonishment at the minuteness of the objects as at the possibility that objects of such a character can be so minute. I have had an opportunity of observing the impressions made upon many minds, on a first introduction to the wonders of the heavens through the telescope, and to the marvels of minute organic life, through the microscope, and in every instance the lively expressions of surprise elicited by the disclosures of this latter instrument have been singularly in contrast with the tranquil admiration excited by those of the former. This susprise is occasionally mingled with something like incredulity. The observer does not hesitate to believe what he sees, but sometimes amusingly doubts whether what he sees is really the object on the stage of the instrument, and is not, by some jugglery, concealed in the tube.

That this doubt is not wholly absurd, or at least unnatural, will be admitted when the actual dimensions of objects are stated, which appear, as seen in the instrument, as large at least as ordinary insects, as bees for instance, or beetles, or butterflies. The *brachionæa* are among the larger forms of loricated animalcules; that is, animals

having silicious loricæ or shells; and of these, the *brachionus urceolaris*, so called from its elegant urn-shaped lorica, is among those most frequently met with. Of this animal more than one million individuals could be easily packed in the space of a cubic inch. But this is one of the forms which may perhaps be properly called gigantic. It is even large enough to be discerned by the naked eye; not indeed in its shape and structure, or the puzzling and paradoxical appearances presented in the movements of its marvelously delicate organs, but as an animated point rapidly speeding its way through the watery drop which forms its ocean. Of this and allied genera or families, there are, however, others which, though equally complex in their organizations, are vastly more minute. Of the genera *Salpina*, *Euchlanis*, *Monostyla*, and others, all having elegantly sculptured silicious shells, there are some of which at least 10,000,000 to 20,000,000 could find room in a cubic inch of space.

Of simpler forms of life, the minuteness is still more wonderful. The *monadina*, monads, are little spheroidal sacks having a single thread-like filament proceeding from the mouth, which seems to serve the double purpose of securing food and aiding locomotion. Different species vary in their dimensions, few exceeding the 1,000th of an inch in diameter, and some being not more than one 12,000th. The monads are commonly regarded as being true animals, although some naturalists, among whom may be mentioned our own Agassiz, have held that they are but the germs of various kinds of algae. They are distinguished by great activity of movement, and if their movements are not directed by a manifest exercise of will, it is all but impossible for the observer to escape from the illusion that they are so.

In order that some idea may be formed of the exceeding minuteness of these objects, I will no longer suppose a space so enormous as a cubic inch to be filled with them. I will suppose a cube of only one-tenth of an inch on the edge. A little block of oak of such dimensions would weigh about a quarter of a grain. It might be represented in bulk by a drop of water, such as I might lift on the point of my pencil. Yet within this insignificant space may be easily contained, of some of the smaller forms of these organisms, a number not less than two thousand millions; that is to say, more than double the number of the human inhabitants of the entire earth. Even this will fail to convey an adequate idea of the extreme minuteness of the objects we are considering; for such numbers as millions and thousands of millions are totally inconceivable by the mind. The

names are mere sounds, which serve us for symbols in making computations, but to which it is impossible to attach any clear notions. Let me try another illustration. Draftsmen, and persons who have occasion to make use of divided rules, are aware that a division finer than about 150 to the inch is with difficulty discerned. Few eyes will distinguish lines closer than 200 to the inch. Divisions so fine as 1,000 to the inch defy the keenest vision to separate them at all. A cube, therefore, having its sides only equal to the one-thousandth part of an inch, is an object invisible to the unaided human eye. But such a cube is large enough to hold not less than 2,000 of the minuter monadin.

The monads are organisms of the last degree of simplicity of structure. They interest by their extreme minuteness, and by the fact that they are living things; but neither in their forms nor their integuments do they present any remarkable degree of beauty or variety. In this respect the loricated vegetable cells called diatoms, are of much higher interest. Of these the greater portion are more or less elongated and bear considerable resemblance, in a lateral view, to a weaver's shuttle. Others are circular or disk-shaped; others still square, triangular, wedge-shaped, or having the form of simple rods. The cell walls of all these objects are silicious, though the silex is interpenetrated by organic matter, which remains and preserves its form after the mineral portion has been dissolved by hydrofluoric acid. These walls are marked with the delicate and beautifully varied patterns of which I have spoken, and being indestructible by ordinary causes of decay, they persist after the life of the organism has perished, and become accumulated in vast quantities wherever these forms of life abound. Diatoms are found in great numbers in all waters which favor at the same time the growth of the higher orders of vegetation, and in the ooze which settles at the bottom of all lakes and seas, their silicious shells form a conspicuous part, constituting often, much the larger portion of the deposit. Some of them are of considerable dimensions, measuring the 100th or the 200th part of an inch in length or in diameter, many much less. Of the elongated forms, the cross section hardly exceeds on an average, the 500,000th part of a square inch, and is sometimes as small as one 5,000,000th. The slate of Bilin, in Bohemia, which is pulverized and sold extensively as a polishing powder, is made up almost exclusively of these fossil remains, of which 40,000,000,000 of individual shells are contained in a single cubic inch.

There are forms still more minute than these. Of the *Navicula radiosa*, one hundred and fifty thousand millions; and of the *Navicula Mediterranea*, three hundred and fifty thousand millions could be contained in the same small compass. The *Navicula viridis* is the smallest of the vegetable forms of which I have the measurement; and this is so minute that a cubic inch would easily contain more than a million of millions. And the minuter monad forms of which mention was just now made, are smaller than these in the ratio of two to one.

Whether the lowest limit of organic life has yet been reached by the power of the microscope, is, perhaps, uncertain. The *monas crepusculum*, the twilight monad, was so named by Ehrenberg as marking, in his opinion, the dawn of life; but though among monads specific differences are not very sharply defined, there are monads now in the catalogue which do not measure in diameter more than the tenth part of the measurement given by him for the *monas crepusculum*.

Upon the process of the development and growth of living things, and of the building up of the most complicated structures from the most simple germs, the microscope has thrown a light which could have been derived from no other source. Thus, the multiplication of cells by binary subdivision, which seems to be a universal law, is a discovery exclusively due to the microscope; and this instrument furnishes us all the knowledge we possess of those acts which are essentially distinctive of vitality. From this law of binary subdivision there follows a curious consequence in regard to those beings which consist in their full development of only a single cell. For, whereas, by cell subdivisions the more complicated organisms grow larger, but maintain, after all, a compound individuality still, among the *desmids* and *diatoms* every subdivision of a cell produces two distinct individuals where there was only one before. And what is true of the unicellular plants is equally true of the unicellular animals. Every subdivision of a single animal—and this process of subdivision is one which may be watched with the microscope from beginning to end—produces two animals in all respects perfectly similar, of which it would be impossible to say that either the one or the other is parent or offspring. This process among these humble forms of life is going on incessantly. As a consequence, if there be but one or two individuals in an infusion to-day, there may be thousands to-morrow. Prof. Ehrenberg, from his observations upon the

multiplication by subdivision, or fissuration, of a few individuals of a single species of *paramecium*, computed that in a month 268,000,000 might proceed from a single one.

But another curious discovery has been brought to light by the microscope among these humble forms of life. The unicellular plants are generally, at least at some period of their existence, free; and not like the larger vegetables, anchored by stems for life to a particular spot. And with their freedom they possess a power of locomotion which likens them wonderfully to the animals which they so much resemble. Some of them are almost always in rapid motion; the movements of others are sluggish. But the very same thing is true of the unicellular animals; for of these, certain forms, as the *amaebas*, the *actynophrys* and the *rhizopods* execute movements which are almost insensible; while others are so restless that it is difficult to follow them with the instrument.

The motions of these minute forms of vegetable life so simulate those of sentient beings, that it is not surprising that they should all have been for a time classed among the animals. But the further discovery, due also to the microscope, that the property of locomotion belongs universally to the germ spores and antheridia of all cryptogamic plants, as is beautifully illustrated in those of all the ferns, mosses, lichens, and fungi, has demonstrated that this property is without any peculiar significancy. The microscope has thus traced the members of the two great kingdoms of the organic world up to a point where all ordinary distinctions fail, and where apparently no real distinction exists. Is there, then, actually no essential or radical difference between the plant and the animal? And are the wide apparent differences between the higher forms of these organisms, only varying modes of development from germ cells originally essentially the same? This is not by any means the case. Between the unicellular plant and the unicellular animal there is a line of demarcation as positive as that which divides the oak from the elephant. The oak derives its nourishment from the mineral world, the elephant from the organic. No animal can live on mineral food, upon earth, or air, or ashes. No plant can assimilate organic materials, the flesh of animals or the substance of other plants. The organic matter of soils, or of the fertilizers applied to them, affords no subsistence to the growing crop till by decomposition it ceases to be organic. This distinction is as decided among the minutest and simplest of the forms of living things as among the most conspicuous and complex.

All true microscopic animals, like other animals, may be seen to ingest and digest their food; and this food consists always of other animals which are their natural prey, or of the lower orders of vegetable life; while vegetables draw their support from water, carbonic acid and ammonia, and set free oxygen under the influence of the light of day. These animals, therefore, cannot live in waters perfectly pure, nor in waters which contain only mineral impurities; and a knowledge of this fact may serve to relieve the minds of those whom the unguarded statements of some writers have led to believe that all waters are at all times swarming with animalcular life. In the waters of the Croton as it reaches our dwellings, I have rarely detected any living thing, either animal or vegetable. In the examinations of this water, constantly kept up under the direction of our Board of Health, traces of life are occasionally detected; but, perhaps, it is well enough to observe here, that should any source of water be anywhere found to be absolutely, and at all times free from every indication of the presence in it of microscopic life, the presumption would be rather unfavorable to its wholesomeness than the contrary; since water which will not sustain animalcular life is hardly fit for man; and water which will do so will never be wholly and permanently without it.

Besides the distinctions here pointed out between the humbler forms of animals and vegetables, there is a second which seems to be no less characteristic. The cell-wall of the unicellular animal is single, while that of the unicellular vegetable is double. The inner wall of the vegetable cell resembles the wall of the animal cell, and is albuminous in its nature. The external wall is of the nature of cellulose, a substance never found in any part of any animal, but which has an elementary composition resembling that of starch, and in physical properties is best illustrated by the fiber of cotton. The two walls of the vegetable cell often adhere so closely as to be separated only with extreme difficulty, but there is no reason to doubt that they are always present.

From what has just been said, it will be perceived that the distinction between microscopic plants and animals is not one which is obvious to mere inspection, or, indeed, one which can be certainly detected without patient observation. And the difficulty is heightened by the fact that while we see plants exhibiting apparently all the visible characteristics of animals, we see animals also assuming the forms and singularly simulating the habits of plants. The *vorti-*

cellæ are bell-shaped animals, resembling flowers, each fixed by a delicate and flexible stem; the *zoothamnia* are flowering trees, in which a multitude of ramifications proceed from a single trunk equally flexible; and though all these exhibit excessive irritability, contracting themselves suddenly on the slightest alarm, yet in this fact there is nothing to which we have not something like a familiar parallel in the *mimosa sensitiva*, or the flower called *Venus's fly-trap* among well known plants. The *zoothamnia* also *grow* like plants putting out new branches from time to time, till from a single individual there spring up scores, all having a separate, and, at the same time, a common life.

This plant-like mode of increase characterizes indeed very strikingly an order of animals which, though microscopic, are higher than the mere *infusoria*. The *hydrozoa*, or fresh-water polyps, not only present a plant-like appearance, but put forth buds like plants, which buds become developed into perfect polyps themselves, and then separate from the parent to seek an independent life. These polyps are little animated sacks, fixed by the base, and having their own mouths surrounded by a number of arms or tentacles, which are the organs by which they seize their prey. The power of contractility and extension of these arms is surprising. In length they exceed often enormously the body of the animal, which, however, possesses the power of withdrawing them until they almost disappear. Often from the same polyp several germs will be seen to be simultaneously springing, and these will sometimes put forth secondary buds of their own before they become separated from the parent stem.

Another remarkable characteristic of this polyp is the tenacity of its vitality, and its power of repairing any injury which it may suffer by violence. If it be deprived of its tentacles they will speedily be reproduced. If the whole head be cut off a new head will presently be formed; and, more than that, the severed head will presently provide itself with a new body. Some curious experiments of this kind were made by Mr. Trembley, the first observer of this interesting object. He cut an individual longitudinally into two equal parts, leaving the parts slightly attached at the lower extremity. Each half speedily replaced the half it had lost, and thus were formed two complete animals, remaining still united at the base. The experiment has been carried still further. A hydra has been cut into nearly forty fragments, and every one of the fragments became, in a short time, an entire animal.

The food of the polyp is received into the cavity of its body, and there, though there is no visible digestive apparatus, it is nevertheless digested. But, curiously enough, if the animal be turned inside out, so that what was its exterior surface becomes its stomach lining, it manifests no inconvenience. Its food is received and digested quite as well as before.

To return once more to the vegetable world. The light which the microscope has thrown upon the processes of reproduction of cryptogamic vegetation is very remarkable. Before the application of the instrument to the study of these organisms, plants of this series were supposed to form an exception to the law which governs vegetable reproduction generally. In all of them, however, have been clearly recognized, by the aid of this powerful instrument of investigation, the entire apparatus which is so conspicuous in the anthers and the pistils of the phanerogamic series, so that the seeming exception does not exist. It has been proved also, that among the fungi different forms of fructification appear in the same individual, and some reason exists for believing that microscopic fungoid vegetation is in great measure determined in all the visible forms of its development, by the conditions to which the different germs may be subjected. The number of sporules which a single fungus may produce is beyond computation. It has been calculated, says Dr. Carpenter, that a single individual of the puff-ball tribe may send forth no fewer than 10,000,000; but this seems to me to be a number far below the real mark. "Their minuteness," the same writer continues, "is such that they are scattered through the air in the condition of the finest possible dust; so that it is difficult to conceive of a place from which they should be excluded. Hence we are not obliged to suppose that distinct germs are floating about in the atmosphere, for all the forms of fungous vegetation which appear to be of different species, and which are only found in particular situations—the *puccinia rosae*, for instance, only upon rose bushes; the *Isariah felina*, only on the excretions of cats in humid and obscure situations, and *Oxygena exigua* upon the hoofs of dead horses; but are warranted in believing that the real variety of germs is comparatively small, and that the facts just stated only indicate the modifying influence of the circumstances under which they are developed."

This view gives a seeming of probability to the opinion entertained by some microscopists, that the fungoid vegetation which attends many forms of animal and vegetable disease is not so much a cause

as a consequence of the disease—the fungi germ finding no congenial soil for its development in the healthy organism, but appearing when a morbid condition has been already established. But to this view is opposed the fact that diseases known to be attended with fungoid growths may be communicated by inoculation with the germs of the fungi; while on the other hand it may be urged that inoculation is a much more effectual mode of introduction than the mere external contact of the germs with the mucous membrane. The question is too large to be discussed here; but what is a truth beyond question is, that certain diseases which are known to be highly infectious, and others which are often epidemic, are actually attended with a large development of fungoid vegetation. Of the first class may be mentioned the small-pox, the fungoid nature of which has been demonstrated by the able researches of our countryman, Dr. J. N. Salisbury, of Cleveland, Ohio, and of the second, the cholera. Dr. Salisbury has also shown that typhoid fever is occasioned by a fungus in the blood, which destroys the white globules, filling them with its spores.

There are various cutaneous diseases in which a fungoid growth accompanies a morbid condition of the skin, of which it is either the cause or the consequence. The *tinea favosa*, a disease of the scalp, happily rare, covers the head with yellow scales, which consist almost wholly of such a vegetation. The thrush in the mouths of children is made up of white patches of similar vegetable character. On the other hand, there are often parasitic vegetable growths lining the stomachs or portions of the alimentary canal of insects and higher animals—sometimes even of man himself—which produce no immediately injurious effects. Some of these exhibit great variety and not a little beauty of form. In the stomach of an herbivorous beetle, the *passulus cornutus*, which lives in stumps of old trees and feeds on decaying wood, Dr. Leidy, of Philadelphia, found a very luxuriant growth of this kind. The breathing tubes of insects are also often choked with similar vegetation, especially in warm countries; the spores having been introduced through the spiracles or breathing pores in their sides. Dr. Carpenter remarks that it is not at all uncommon in the West Indies to see individuals of a species of Polistes, corresponding to the wasp of England, flying about with plants of their own length projecting from some parts of their bodies. And similarly it may be remarked that we often see minute little crustaceans, the Cyclops of the Cypris, so small as to seem only like

moving points in the water, when placed under the microscope, to be loaded down by stipitate diatoms, unicellular vegetables having stems, or by tubicolar animalcules, little animals which construct for themselves tubular dwellings, without nevertheless seeming to occasion the animal which carries them the slightest inconvenience.

The microscope furnishes the means of discovering the chemical nature of substances when in quantity too minute to be treated by ordinary methods of analysis. It does this by detecting characteristic forms of crystallization, as in investigations for the detection of poisons, organic or mineral, or by showing the action of reagents precisely as when testing on the large scale in the usual way, or by showing the peculiar optical effects produced by polarized light, or by simply making manifest the mechanical structure of the object under investigation. In questions of medical jurisprudence the information it furnishes, is thus often decisive. Its testimony as to the nature of stains supposed to be blood, and as to the question whether the blood, if present, is that of man or beast, is beyond appeal. Mr. Gosse mentions a case which strikingly illustrates this statement. A man suspected of a murder was found with a bloody knife in his possession. He accounted for the stain by saying that he had been using the knife for cutting beef. The implement was given to an expert with the microscope, who pronounced that the blood was human blood, and that it had proceeded from a living body and not from dead flesh. He discovered also, mingled with the blood, certain vegetable fibers, which he pronounced to be cotton, and which were found to agree with the material of the murdered man's neckcloth. And he found also present numerous tesselated epithelial cells—such cells as line the mucous membrane of the throat, and of no other part of the body. It was evident that the knife had been used to cut the throat of a human being, who wore a cotton neckcloth at the time. The decision of the instrument as to the presence or absence of poisons, is often equally conclusive. In one instance, in England, a criminal was convicted on the evidence of the sand which he had brought on his boots from the scene of his crime, and which the microscope unerringly traced to its true locality.

In the detection of the adulteration of drugs, groceries and other articles of daily commerce, the microscope is infallible. At the office of the Surgeon-General, in Washington city, all the supplies purchased or tendered for purchase, for the military hospitals and medical stores of the army, are subjected to constant and severe micro-

scopic examination, and in this manner an immense amount of fraud is prevented and an immense saving secured to the Government. A very common form of adulteration in quinine and other valuable powders used in medicine, is to mix with them powdered gypsum, sugar or starch. The microscope infallibly picks out the fraudulent particles, and the use of polarized light greatly facilitates the discovery. Each starch granule exhibits, indeed, with this species of illumination, a distinct black cross, and, to use the words of the late Horace Mann, in speaking of this fact, seems to be crying out with all its might, "Potato Starch, his mark."

The microscopic study of the elementary tissues of the higher order of animals has also shown, along with a marvelous simplicity and conformity of general plan, such endless variety of detail, and such constant association of each variety with a particular natural group, that, in the vertebrated series, it is almost invariably possible, by the examination of the minutest fragment of bone, for instance, to pronounce with confidence as to the natural family to which it has belonged. This is the more especially true in regard to the teeth, whose peculiarities of structure have been so thoroughly studied and demonstrated by Prof. Owen, that it is, in general, possible to distinguish even genera and species. When it was announced that Baron Cuvier, by the help of a single bone, as, for instance, a tooth, would undertake to reconstruct the entire skeleton of the animal of which it had been a part, the statement seemed almost to border on the incredible. But to-day we may go further, and say that, as from the merest fragment, we can reconstruct the tooth, so it is no longer necessary to have a speciman of an animal large enough to be visible to the naked eye, in order to enable us to portray the animal himself.

What is true of the vertebrates is true to a great extent of the other great sub-kingdoms of the animal world, the structure of their harder parts, the shells, for instance, of mollusks, crustaceans, &c., having a regularly organized structure, varying with the different groups, but invariable for the same, so that a microscopic fragment of any such solid suffices, as a general rule, to fix the place of the animal which produced it, in the scale of organic life. Similar differences characterize the softer and more perishable parts of the higher animals, the cartilages which cover the articulations, the ligaments which bind them together, the muscles which produce motion, the tendons which transmit it, the brain, the ganglia, the nerve tubes, the membranes and the skin. Of all, or most of these, the structure

presents characteristics easily recognizable, under the microscope which point to the animal of which they have formed parts. A curious illustration of this truth is mentioned in the Transactions of the Microscopical Society of Great Britain, as having occurred a few years since in England. A tradition had been current, time out of mind, that the skin of one of the Danish pirates who, more than a thousand years ago, were accustomed to ravage the eastern coast of the island, and who had been captured and put to death, had been nailed to the door of the neighboring church, as a perpetual terror and warning to his tribe, and the very nails were pointed out by which it had been fixed in its place. A curious antiquarian having, by close scrutiny, discovered adhering to one or two of these nails something which seemed to him like a minute shred of leather, carefully detached it, and submitting it for examination to a microscopic expert, when the peculiar structure characteristic of human skin presented itself, and indicated the truth of the tradition. The minute hairs, also, which accompanied the specimen were pronounced to have belonged to a fair-haired man, such as the Danes were known to have generally been.

When we descend lower in the scale of being, however, the characteristic differences of organic structure become less and less marked, until in the very lowest forms, the whole organism, whether animal or plant, seems to be made up of entirely homogeneous cells. And this, which is the permanent condition of these lowest forms, is shown by the microscope to be equally the temporary condition of the highest, even of man himself, when his life history is traced back to its origin. There is no animal whatever, which, in its embryonic condition, is anything more than a congeries of perfectly undistinguishable cells.

The foregoing observations may serve imperfectly to illustrate the importance and value of the microscope as a means of scientific investigation. And they may serve to illustrate also to what extent science, in all its departments, is dependent for its advancement upon the gradual improvement of the instruments of research. But for the telescope, astronomy might have remained stationary to this day at the point where Tycho Brahe and Kepler left it, and all the magnificent conquests of this grandest of sciences during the last two or three centuries might have remained still unachieved. But for the balance, chemistry might yet continue to be an unwieldy mass of incoherent truths, instead of rivaling, as it does at present, the severe

method of the exact sciences. The doctrines of static electricity only assumed the form of a science after the invention of the balance of torsion; and dynamic electricity is under obligations equally great to the ingenious instrument called the galvanometer. Mineralogy owes the exactness of its determinations to the reflecting goniometer. The brilliant advances of the present century in physical optics have been aided in a marked degree by the polariscope. Very recently chemical analysis has found in the spectroscope an admirable auxillary to the delicacy of its determinations, an auxillary which has already brought to light four new metals, of which the existence had not been previously suspected, and which is busying itself successfully with the elementary constitution of the sun, the fixed stars and the nebulæ. In the field of physiology and structural anatomy, it is the miscroscope which has occupied the first rank among the instrumental aids to investigation, and which may almost be said to have created the science which it illustrates, in proportion as it has itself advanced toward perfection.

I will now endeavor to explain, in as brief a manner as possible, and with the help of illustrative diagrams, the construction of this beautiful instrument, and the principles on which its usefulness depends.

The name microscope defines itself. It is formed from Greek words, signifying to observe the minute, as telescope signifies to discern the distant. Microscopes have been constructed upon the principles of the reflection of light, as well as upon those of refraction. It is the refracting microscope which is in common use. To understand its construction it is necessary to refer to some elementary properties of light. A *medium* in optics is any space through which light can pass, whether it be void or occupied by matter in a solid, fluid, or gaseous condition. Rays of light passing from one medium to another, perpendicularly to the bounding surface, maintain their direction unchanged. If inclined to this surface, they abruptly change their direction, or are refracted. As a rule, the ray will be nearer to the perpendicular in the denser medium than in the rarer. The *angle of incidence* is that made by the incident ray with the perpendicular, the *angle of refraction*, that made by the refracted ray with the same perpendicular. The *law of refraction* is, that the *sine* of the angle of incidence, divided by the *sine* of the angle of refraction, gives invariably the same quotient. This *quotient* or *ratio* is called the *index of refraction.* Parallel rays transmitted at any inclination,

through media bounded by parallel faces, continue to be parallel. Diverging or converging rays, under similar circumstances, become more diverging or less converging. If, before transmission, they were diverging from a single radiant, they no longer have this character after transmission, but are said to be affected by *aberration.* This effect sensibly disturbs the performance of the microscope when used to observe objects covered, as many are, with thin glass plates, and requires a special contrivance to counteract it. Parallel rays falling on media having faces inclined to each other will be unequally refracted by the different faces, and may be made relatively to diverge or converge after transmission. It is evident that the faces may be so multiplied and so adjusted to each other as to make all the transmitted rays intersect in a single point. To make this rigorously true, the faces must be infinite in number, or the surface must be a *curve.* It is not difficult to determine mathematically *what* curve or curves are proper to produce this effect. An ellipse will do it. Elliptic curves are not, however, used in the construction of the microscope.

The name lens is given to solid media employed in optics to concentrate or scatter rays of light. Only spherical curvatures are given to lenses. Some disadvantages attend this curvature, but they are, in practice, effectually overcome; and it possesses advantages, on the other hand, which belong to no other. The points of intersection of convergent rays are called foci. The focus of parallel rays is the principal focus. The term radiant is applied to a focus from which rays diverge. Rays from a radiant more distant than the principal focus of a convex lens will converge to a second focus on the other side of the lens. The two are called conjugate foci. Rays from a point nearer to the lens than its principal focus will emerge divergent, but less divergent than before, as if they proceeded from a more distant radiant. This more distant radiant is called the imaginary or negative focus, and is still the conjugate to the original radiant. With concave lenses, the effects are all the reverse of those just described. If, instead of a single radiant, an object of sensible magnitude be placed before a convex lens, more distant than its principal focus, every point of this object may be considered an independent radiant, having its corresponding conjugate focus, and these conjugate foci will combine to produce an image of the object, which will be inverted and reversed. If the object be nearer than the principal focus, as all the emergent rays will be divergent, no

real image will be formed; but there will be a negative or imaginary image on the same side of the lens as the object. If the eye of an observer be placed behind the lens, looking toward the object, this imaginary image will appear to be real, and will be the thing seen. Spherical lenses do not produce true foci. Hence the images formed by single lenses are imperfect. When parallel rays are transmitted through a convex lens the focus of the central rays is more distant than that of the marginal. Intermediate rays form foci at intermediate distances. The space along the axis of the lens through which these several foci are distributed is called the *spherical aberration* of the lens. If a lens is unequally curved on its two sides, the amount of its aberration will differ according as one or the other side is presented to parallel rays. Generally speaking, parallel rays should be received on the side having the largest curvature.

The aberration of concave lenses is the reverse of that of convex. A concave lens, combined with a convex of greater power, will lengthen the focus, but not prevent its formation. Such a concave lens in the position of maximum aberration, combined with a convex in the position of minimum aberration, will neutralize aberration entirely, and produce a perfect focus. This is the principle on which the first of the grave difficulties in the construction of the microscope is overcome. Aberration would be less in lenses formed of substances more highly refracting than glass—as diamond, sapphire, topaz, and other gems. Such lenses would be thinner than glass lenses of equivalent power, and aberration is in a definite ratio to the thickness. In a plano-convex lens it is four and one-half times the thickness with the flat side toward parallel rays, and only one-sixth of the thickness with the convex side toward parallel rays. But the costliness of these gems, the difficulty of grinding them, the color of some of them, and the property of double-refraction which they all possess, are disadvantages greater than the evil they are proposed to remedy. Moreover, this evil has been effectually eliminated, and they are not needed. But there is another aberration no less troublesome than the spherical, which is called the chromatic. Common white light is composed of elementary rays differing from each other very sensibly in refrangibility, and also in color. The familiar experiment with the prism illustrates this. The extreme colors are the red and the violet; but as the violet is very faint, we may regard for our present purposes the red and the blue as representing the limits. The blue rays exceeding the red in refrangibility, will form an image nearer to

the lens than the red. And between these images will be formed others by the intermediate rays. The total number of images thus formed is unlimited, and superposed upon each other their effect is to produce confusion. Color will be visible only at the margin of the blended images. Chromatic aberration is the second great difficulty to be overcome in the construction of the microscope. It happens, fortunately, that the separation of the colors (technically called dispersion) by the different media, is not proportioned to the refracting power. As the dispersions of convex and concave lenses are in opposite directions, a combination of two such lenses may be obtained, in which dispersion shall be neutralized, while there still remains a balance of refracting power outstanding. Thus a concave lens of flint glass will correct the dispersion of a more powerfully refracting convex lens of crown glass, and the image formed by the combination will be colorless. It is then a mathematical question to find the curvatures proper to be given to such lenses, so as to correct spherical and chromatic aberration at the same time.

A third great difficulty to be contended with in the construction of this instrument, results from the fact that the image of a plane object formed by any single lens, is not plane but curved. A flat object observed through an eye-glass, seems to round up toward the eye, in the center. A positive image of such an object, formed by a convex lens, is hollowed out or concave, toward the lens. Moreover, though the spherical aberration may be corrected for the axis of the lens, it will not be so for the oblique rays. Distortion of the form of the object observed and confusion in the marginal portions of the image will therefore still remain, even after the corrections above described have been made. To conquer this last difficulty, so as to produce a perfectly undistorted image and an entirely flat and clear field, has exacted the largest amount of study and skill which the problem has called into exercise. The complete solution is only obtained by combining the effects of all the parts of the compound microscope, of which we shall presently speak. One word is first necessary in regard to the phenomena of vision. The eye is an optical instrument, in which an image is regularly formed as in the camera obscura. The sensitive surface on which this image falls is called the *retina.* The eye can accommodate itself to the distance of the object, so as within limits largely variable to maintain the image on the retina distinct. The image on the retina must have a certain size, very small no doubt, but ascertainable, in order that we

may see it all. As the object recedes the image diminishes. The light from it at the same time grows faint. Owing to these causes combined, there is a limit of distance, beyond which we fail to perceive objects which themselves have an appreciable magnitude. As an object approaches the eye, its image on the retina grows larger, and points in it, which, at a greater distance were below the *minimum visibile*, become perceptible. But there is a limit within which, if we bring it, it ceases to be distinctly seen, because the eye has no longer power to maintain a clear image on the retina. This is called the limit of distant vision. Any contrivance which will enable the eye to form such a clear image without requiring the object to be carried further off, will show the object unnaturally large. If we look at the letters of a printed page through a puncture made by a needle in a card, this magnifying effect may be observed. The confusion of the image is very nearly removed by the effect of the puncture in cutting off all but the central rays of each pencil from the object.

A convex glass introduced between the object and the eye, the object being nearer than the principal focus of the glass, produces a similar effect, but more perfectly. The glass does not *enlarge* the image on the retina, but it aids the eye in clearing it up. What the eye in this case sees, is the image formed in the negative focus of the glass, conjugate to the focus occupied by the object. This negative focus must, of course, be at least as far off from the eye as the natural limit of distinct vision. This limit is not the same for all eyes. It varies with individuals, from seven or eight inches to eleven or twelve. For all purposes of computation, in estimating the powers of the microscope, it is taken invariably at ten inches. The magnifying power of a lens, is the apparent increase expressed in numbers, which it gives to the diameter of the image of an object above that of the object itself as seen at the limit of distinct vision. It may be determined by observing the object through the glass with one eye, while with the other a rule is observed held before it at the distance of ten inches. The image will be seen superposed upon the rule, and the enlargement may be directly read off. Very large magnifying powers have been obtained with single lenses. The early microscopists, Leuwenhoek, Swammerdam, Hooke, Lieberkuhn, and others, used such exclusively. They formed them, in many instances, by melting minute fragments of glass, which, while fluid, assumes the spherical shape, and on cooling may be used without grinding. But to use

with effect, in investigating, single lenses of the large power, requires consummate skill. If the power is great, the lens must be exceedingly small. The image, except exactly in the center, is greatly distorted. The *working distance* is very small, both for the object and the eye. All these objections are obviated by the use of the *compound microscope.*

In the compound microscope an image is formed of an object by one convex lens, and this image is observed by a second. The first image is much greater than the object, and this being a second time magnified, the resultant effect is expressed by the product of the numbers representing the separate effects. If the object glass magnifies twenty times, and the eye glass five times, the total enlargement will be 100. The image is inverted relatively to the object, but this is unimportant, as generally the object itself may be placed in any position. The form of the compound microscope facilitates greatly the correction of the aberrations of sphericity and color, and that of the curvature of the field and the distortion of the image. Though the two lenses only are required, in order that we may state the principle of the instrument, a number are necessary for the purpose of affecting the corrections just mentioned. In the first place, the aberrations are much reduced by employing, instead of a single lens for the object glass, a combination of three. Aberrations increase rapidly with curvature. Three lenses of low curvature will have much less than a single one, equivalent in magnifying power to the three jointly. The object viewed is placed within the principal focus of the first of the three forming the combination. The negative image thus resulting, is the object of the second lens, and falls within its principal focus also. A second negative image thus produced falls *without* the principal focus of the third lens, and this lens produces finally a positive image to be observed by the eye-glass. Another very important end is attained by making the object-glass compound. When a single lens has been corrected for the aberrations of sphericity, the correction will be good, only for certain distances of the object from the lens. There are, in fact, only two points for which such a lens will be aplanatic (without aberration). If the object be placed anywhere between these two points, the aberration will be over-corrected, *i. e.*, the foci of marginal rays will be too long, and those of axial rays too short. But if the object be more distant from the lens than the more remote of these two points, or less distant than the least remote, the aberration will be under-corrected. In the compound

object-glass the lenses are so placed, that when the object is in the short aplanatic focus of the first glass, the negative image is in the longer aplanatic focus of the second and third, considered as one, and the aberration is suppressed. But a more important fact is, that the oblique rays, for which the aberration as already stated is not corrected with any single lens, is such as to produce two opposite and counteracting effects in the two points just mentioned; these oblique pencils of rays throwing a luminous coma outward at the longer focus, and a similar coma inward, at the shorter. The two effects balance, and thus the compound objective produces an image free from aberration throughout. Another advantage is secured by the compound objective. When the object is viewed through a glass cover, even though the cover be not more than the one-hundredth or one-two hundredth of an inch thick, the pencils coming from it are made (as has earlier been stated) aberrant. The aberration produced is negative. If the front lens be slightly withdrawn, the others remaining stationary, the object will fall into that space between the two aplanatic foci; in which the aberration produced is positive. The two effects counterbalance each other, and the perfection of the image is once more restored. The corrections here described are founded on discoveries made by Mr. J. J. Lister, of London, and communicated to the Royal Society in 1830. They gave to the instrument a power and perfection previously unknown, and constitute the essential feature of all modern first-class objectives. But though aberrations are thus corrected, the curvature of the image remains to be removed. This is accomplished by invoking the aid of the eye glass, or, as it is more properly called, the eye-piece. The eye-piece is compound as well as the objective. It consists essentially of two plano-convex lenses; the smaller, nearest the eye, being the eye-glass proper, and the other being called, from the use which it was originally designed to subserve, the field-glass. It bends the pencils proceeding from the object glass inward, as is seen on the diagram, and gives the eye a better command of them. It thus enlarges the field of view, though reducing somewhat at the same time the size of the image. But it accomplishes a much more important object than this. The image formed by the rays from the object glass is seen to be curved, presenting its convexity toward the eye. This is the most unfavorable position in which to view it, since the eye-glass itself tends to produce a convexity in even a flat object in the same direction. But the field-glass receiving the rays of the

converging pencils before they reach their focus sends them to another and nearer focus where the curvature is reversed. The two foci are in fact conjugate, but one is negative to the other. The image thus formed by the field-glass is concave toward the eye; and this is the kind of image to which the conjugate seen through the eye-glass is flat, or less rounded, or rounded the other way. It is a mathematical problem easily solved to assign the curvatures to the several glasses, which shall produce exactly the flatness of field desired. But we are not yet done with all the useful effects of this admirable combination. The eye-glasses may produce color as well as the object glasses. To make these achromatic also would require unnecessary trouble and expense, since the same effect may be produced in another mode, which I will now describe. The object glasses are corrected for color in excess. That is to say, the blue image of the corrected glass is formed further from the lens than the red image. The reverse is the case with the uncorrected glass. The diagram before us shows the relative positions of the two images. These two images are somewhat approximated by the convergency produced by the field-glass, which, being uncorrected, acts more powerfully on the blue than on the red. The margins of the two images are also brought into straight line with the axes passing through the center of the eye-glass, which axes are the boundaries of the negative resultant image finally seen by the observer. The eye-glass, acting like the field-glass, more powerfully upon the blue than upon the red, brings both at last into perfect coincidence, so that the ultimate image is divested of all its imperfections: it is without aberration, without distortion, without color, and without curvature.

These results are not by any means secured with the facility with which I speak of them here. The utmost delicacy is necessary in the adjustment of the several parts; the most careful computations are indispensable for the determination of each curvature; and, finally, the most exquisite artistic skill must be laid under contribution to realize in execution the exactions of theory. If to any production of the combined resources of art and science the term masterly is justly applicable, it is so in an eminent degree to the modern perfected microscope. The question is sometime asked, what are the tests by which a good microscope may be recognized? It may be answered that a microscope should be chosen with reference to the purpose to which it is to be applied; but that there is one quality without which no microscope is valuable for any purpose,

and that is what is called defining power. By this is meant the powers of delineation of the outlines of the objects observed. Great powers of enlargement seem to be supposed by many to be the most important property; but without sharp definition, no magnifying power is of any value, for definition is necessary that the object may properly be seen at all. Great magnifying power is indeed for many purposes a disadvantage rather than the contrary. To see an object in whole, or any considerable part, it is generally indispensable that the power should be low; and it should always be remembered that when the power is high enough to permit us to see what we want to see, to increase it would be worse than useless. The field on the stage commanded by a power of one hundred is hardly more than the twentieth of an inch in diameter. With a power of one or two thousand, a puncture of a fine needle in a card would more than represent the entire space which the observer could see at a single view. Hence, except for the very minutest objects, high powers define only details of structure, not by any means forms and outlines. Defining power being secured, we need next either penetrating power, or resolving power, according to the uses we expect to make of the instrument. By penetrating power is meant a certain command of the parts of the object which are above or below the plane of the true focus. This property the eye itself possesses in an eminent degree. It furnishes us notions of the relations of parts to each other which cannot be obtained when every point out of an absolutely true focus is utterly confused. Penetrating power can only be satisfactorily secured with objectives of which the magnifying power is low. Resolving power is a name for the degree of efficiency of the instrument in separating fine lines or other delicate markings on the surface of the object observed. This quality is only secured by making what is called the angular aperture of the objective large. The angular aperture is the degree of spread which can be given to the pencil of rays which the objective will transmit. It is by means of the most oblique rays that the minute tracery upon the surface of an object is made most conspicuous. The reason of this will easily appear from the diagram exhibited. The relative distinctness of such markings, as shown on the scale of a butterfly's wing in this other figure, with different angles of aperture, will further illustrate this peculiarity. Resolving power and penetrating power are, for obvious reasons, to a certain extent antagonistic to each other. Hence, both are not to be sought for in the same objective.

The lecturer then proceeded to exhibit and explain different forms of the misroscope, the ordinary compound microscope, the binocular microscope, the inverted microscope, used for chemical purposes, the double, triple, and multiple microscope, the solar, or calcium light microscope, &c.; after which he spoke of the modes of illumination, and described a number of forms of accessory apparatus, together with the modes of measuring the dimensions of microscopic objects, and of determining magnifying powers. He referred also to the wonderful perfection of mechanical art in recent times, as illustrated in microscopic ruling and engraving, and mentioned Nobert's test-plates, of which the finest lines, 120,000 to the Paris inch, have never been as yet fairly resolved. Drs. Curtis and Woodward, of Washington, have made enlarged photographs of these lines, as high as 96,000 to the Paris inch, or more than 90,000 to the English inch. He spoke also of an engraving executed for him last year, by Dumoulin Froment, of Paris, representing the seal of Columbia College, with all its pictorial devices, and its mottoes in Latin, Greek and Hebrew, all clearly legible under the microscope; but the whole executed within a space less than one millimetre in diameter, or about the size of the puncture of a pin in a sheet of paper.

Speaking of the constructors of microscopes, he mentioned a number of American opticians, whose work is unsurpassed by that of the most accomplished foreign artizans. Among the names mentioned were those of Tolles, of Boston, and Wales of New York, both of whom received silver medals at the Paris Exposition of 1867, and also Granow, of New York, and Zentmayer, of Philadelphia. He spoke particularly of the "wet-front," or "immersion" objectives of Wales and Tolles, as surpassing anything of similar power yet constructed abroad. Some time was then devoted to the exhibition of various objects illustrative of the power of the microscope, and of the curiosities of natural history; among which were some beautiful enlarged photographs of *diatoms*, animal muscle, &c., prepared by Drs. Curtis and Woodward, at the Army Medical Museum, at Washington, and lent for this occasion by the courtesy of the Surgeon-General. [This part of the lecture hardly admits of a report.]

The lecturer concluded as follows: I have thus presented you, as well as my ability and the limited time allotted to me would allow, a description of what, perhaps, may be justly regarded as the most elegant of the instruments which modern science has created to aid its investigations, and I have placed before you some examples illus-

trative of the wonders which this powerful instrument has been the means of unvailing to human sight. These last are so numerous, so varied, so marvelous in their forms and movements and habits, and so constantly bursting upon us when least expected, in novel revelations, that I know no study of which the tendency is more improving, refining and elevating, than that which the microscope presents us in the world of the infinitely minute. There is no study which draws the mind more constantly and more irresistibly to the contemplation of that wondrous creative power, which manifests itself no less marvelously in the tiniest monad than in the great beasts of the forest, or the monsters of the deep; or of that comprehensive benevolence which provides alike for the wants of all, from the least even to the greatest. Surveying this vast field of varied life, it is inconceivable how such a thing as an atheist can be. The whole spirit which the study inspires is a spirit of adoration and faith which yearns continually to express itself in language like that of the poet:

> "These are thy glorious works, Parent of good!
> Almighty! Thine this universal frame
> Thus wondrous fair; Thyself how wondrous then,
> Unspeakable, who sittest above these heavens,
> To us invisible or dimly seen,
> In these Thy lowest works; yet these declare
> Thy goodness beyond thought and power divine."

SCIENTIFIC LECTURE.—II.

THE TELESCOPE.

By Professor Stephen Alexander.

Prof. S. Alexander, of the college of New Jersey, Princeton, delivered the second scientific lecture before the American Institute, Friday night, December 4, 1868, in Steinway Hall, upon the Telescope and its relations. Prof. Alexander, on being introduced to the audience, spoke as follows:

That is a noble figure of John Bunyan in his "Holy War," in which the senses are presented as the gates of man's soul, the inlets of knowledge from without. And amongst these and noblest of them all is the eye gate, the messages through which come from afar, and are borne upon the very wings of the morning. Quite as interesting, in some aspects, as the eye itself, is that wonderful emanation, or rather influence, through which we are enabled to see the light itself. All beautiful and glorious as it is when entering through the unbarred gates of the morning, it gilds with glory the drapery of the sky, reveals the distant mountain tops, and unvails that it may adorn the fair face of nature. Even its shreds and patches are beautiful as they sparkle in the diamond, or twinkle in the dew-drop. It comes back all blushing itself because it has kissed the cheek of the blushing rose; it arrays the lily in its robe of spotless white without breaking its stem; paints, without breaking it, the merest bubble, and that with the very colors which fringe the insect's wings, or arrays in all the gorgeousness of the rainbow, the already half broken and dispersed flower. Ah! beautiful and glorious is light. But most grand, most beautiful, and most glorious is it when it reveals to us from afar the glories of the great panoply that surrounds us, when it ornaments its jewels are blazing suns, the altar vestment of His attire, who covereth Himself with light as with a garment, and spreadeth out the heavens like a curtain. Most interesting, in the next place, is the adaptation of the eye to light, and of the eye to the light; but what a simple, what

a telling fact, that this wonderful emanation is poured upon the most delicate organ in its own way in the system with a velocity which would accomplish 250 days' journey by steam in a single second. One would suppose that, poured upon that most delicate organ with that fearful velocity, it would thereby extinguish it forever. No. Truly the light is sweet, and a pleasant thing indeed; it is for the eye to behold the sun, and that simple, natural declaration of the wise man of Israel is responded to in the feelings of every one who once has had the benediction of being able to see. Now, the benediction of both the noble senses is two-fold. In the case of light we not merely perceive brightness, and learn to judge of its forms, and also catch expression, but we have the additional benediction of color, and all that belong to it. So with regard to the other noble sense of hearing. We are not restricted to the mere perception of sound, or even the sentiment of conversation, but we have both the melody and harmony which belong to music. In each of the noble senses, then, the benediction is two-fold. But now we have not to do with mere seeing. The ancient observations of astronomy have been well described as those which required merely eyes, and attention, and patience, and time. We are to speak of that admirable exterior eye—an artificial eye—a noble present from optics to astronomy—one of the grandest we have ever had. We are to discourse of the telescope, and before we do so it may be as well to give you some idea of what constitutes a telescope, and how light is acted upon. [The lecturer here explained at length the principle upon which the telescope is constructed, illustrating his subject by the use of diagrams, &c.] We now come to the history of the telescope. I have here a printed book containing an article by *Prof. Alexander*, and as he is a personal friend of mine (laughter), I will quote from it. He spoke of Roger Bacon as having invented spectacles, possibly in the thirteenth century: "Roger Bacon (to whom allusion has already been made), in his Opus Majus, makes use of such language with reference to what 'may be performed by refracted vision,' as to render it somewhat probable that he was at least acquainted with the theory of a refracting telescope, though there is no sufficient proof that he constructed one; and Baptista Porta is said by Wolflus to have made a telescope, but the description of the instrument given by the inventor is very defective, and the instrument, whatever it was, does not seem to have been used in any celestial observation. Indeed, 'we have no distinct evidence that such an instrument was used before the begin-

ning of the seventeenth century.'* Descartes ascribes the invention of the telescope to James Metius (Jacob Adriansy) of Alkmaer, in Holland; but Huygens, as well as Borellus, to John Lippensheim, or Lippersy (Hans Zans, or Jansen), a maker of spectacles of Middleburgh. Prof. Moll, after an examination of official papers preserved in the archives of the Hague, comes to the conclusion that on the 17th of October, 1608, Jacob Adriansy was in possession of the art of making telescopes, but from some unexplained cause concealed it; and that on the 21st of the same month Hans Zans, or Jansen, was actually in possession of the invention; but there is little reason to believe that it was devised by either him or his son Zacharias, though one of them invented a compound microscope about the year 1590."†

One of the earliest of the telescopes made by the Jansens was presented to Prince Maurice, to be used in his wars. It was in April or May, 1609, that Galileo first heard of this, and the instrument was then described to him as one which had the property of making distant objects appear as though they were near. Galileo thereupon devised how that might be affected, and the next day, according to Delambre, was in possession of a telescope magnifying three times. Galileo's second telescope magnified about eighteen, and his third about thirty-three times."

Now, Galileo did not make use of the telescope just in the form of which we are speaking. Instead of taking the rounded glass or convex lens in order to take hold of the rays after they had come together, he takes a lens of the opposite shape and takes the rays in the opposite state, just before they come together, so that whereas they cross in the modern telescope and produce an inverted image, in the Galileo telescope they are seized upon before they cross, and give an erect image. That is the case with all your opera-glasses, which are all Galilean telescopes. "In so far as appears, the first telescope of Lippersheim magnified about fifteen on sixteen times; and he is said to have observed with it the form of the planet Jupiter, and some small stars (his satellites) which appeared to move round him Be this as it may, those satellites were noticed by Galileo, who also observed their eclipses. He also observed many of the varieties of surface of the moon, with which we are at this day so familiar, as well as the phases presented by Venus and Mars, and the spots upon

* Sir David Brewster says this in his "Optics;" but in a curious old book called the *Rara Mathematica*, by Halliwell, it was said that a telescope was made by Leonard Digges about 1571, and may have been used for terrestrial purposes.

† So says the Journal of the Royal Institute.

the sun, in which last, however, he was anticipated by Harriott, in England." This was at the beginning of the seventeenth century. But we have already mentioned several interesting objects that the telescope had thus brought to view. What were they? Satellites of Jupiter? Yes. Here is one of them [pointing it out upon a diagram]. Here is the form of the disc of Jupiter, which is a great deal better seen in modern telescopes. Jupiter has four satellites, and here is the shadow of one of them upon the face of the planet. These are the belts of Jupiter, which are supposed to be substances in his atmosphere; for Jupiter is now proved to have an atmosphere; and thus it is with Mars, and with Saturn. How is it proved? By means of the spectroscope. How does the spectroscope show it? Assuredly I will not anticipate the lecture by explaining it. There are substances floating in the atmosphere of Jupiter. His shape is not round. It is much shorter in a north and south direction than in the other. He turns round in less than ten hours, and the outward fling of that turn swells out notably on one side, so that you can see at once that he is not round. But at the same time Galileo saw the moon. What do we see when we examine the moon with the telescope? The edge of it is all ragged; when if it were a smooth globe it ought to be smoothly cut; and in the quarter-moon when the edge of the circle is turned toward you, as the edge of the glass, it ought to appear a smoothly cut straight line. It is not a smoothly cut straight line by any means. The moon, then, is horribly rough. The mountains are struck by the sun's rays before the plains receive them. The tops of the mountains will therefore appear illuminated, like a round spot in a disc, or a star in the dark. Then, as the sun ascends, the light rises higher till at last the whole edge of the mountain will be illuminated, while all the rest is in shade. We observe by looking near the edge of this diagram that it is the shape of a cup or crater, for that is the law of construction with the mountains of the moon; and you will see by the beautiful photograph of Mr. Rutherford's, and also by another on the same scale, which Mr. Henry Draper has executed of the old moon (this is the new moon, at the first quarter), that the little mountain-tops, like islands in the dark, appear before the rest is illuminated. Then the mountain shadows lengthen as the sun goes down; they point always in the direction opposite the sun; they point toward the north in the northern hemisphere, toward the south in the southern hemisphere. Another shape is commonly that of an enormous volcano; and, although you would not assert that

volcanoes had just been burning there, they account for all the resemblance in the ragged walls, in the cone inside the mountain, in the openings of the small craters along the sides, shadows and all. Volcanic action might go on in the moon on an awful scale. Why? Because things weigh one-sixth there what they do here, and fire might act with prodigious intensity. You might jump, if you had the muscular energy preserved to you, six times as high as on the earth, and you would be six times as long coming down. Things are thrown, up there, more easily. And the moon is not made of such stern stuff as the earth. The density of the earth is five times that of the moon. Volcanic fire might there have an awful arena for exhibition; and, accordingly, there are great craters, probably fifty, sixty, almost a hundred miles across, and three miles deep. "Do you think, sir, there are mountains in the moon?" I may be asked. Do I *think so*? My dear sir, that is beyond the region of "I think;" I *know* there are. But examine the sun once, and what do you see on it? It has not a uniform bright surface, but you see it broken by black spots. Those spots seem to indicate that they are hollows; although I cannot stop to insist upon that. But those spots are hollows below the surface. How large are they? [The lecturer here illustrated from the diagram the relative size of the sun and the planets that surround it.] The diameter of the sun is a hundred times the diameter of the earth. The surface is equal to 100,000 oceans much larger than the Pacific; all that is full of agitation throughout, and tossed into waves of insufferable splendor, thousands of miles long. Oh, when we look at the sun, as like a giant he begins his daily course, or when arrived, in full-orbed meridian splendor he almost seems to pause a moment to look down upon the world rejoicing in his presence, or when he sinks to rest, arraying himself in the splendid garments of the evening, under any and all those circumstances he is at once the fitting representative and the chosen emblem of all that is great and beautiful. How large are these craters? [The lecturer here pointed out a crater represented on the diagram of the sun.] Look at the earth and see how easily it could drop in, and how much margin would be left. These great openings open and close sometimes in the space of three or four days. The changes are prodigious. We cannot stop, however, to speak of the structure of the sun any further than to say that the stereoscope has told you, that there is iron there, and magnesium, and sundry other things. The phenomena of Mars, we noticed by the telescope a few

moments ago. Mars has an atmosphere and, strange to say, he has a year two years long. When one of the poles comes out of that long winter of a whole year's duration, some how or other it is all clothed in white; and when it is exposed to the sunshine long enough, that white appearance is gone again. How like it looks to a formation of snow and ice on the earth, whether the same sort of material or not. But Mars has moisture in his atmosphere, and why may not, therefore, the accretion be exceedingly like that on the Earth? So far, then, for what the telescope tells us. Huygens made use of a telescope of full twenty-three feet in length and four inches aperture (*i. e.*, diameter of object glass), which he reduced to two and one-eighth inches. He also discovered a satellite to Saturn. In 1671 Cassini discovered another satellite, and afterward three more. He also perceived the ring of Saturn to be double, soon after his establishment at the Observatory of Paris in 1675. It seems, however, that he was anticipated in this discovery by two English amateurs, Dr. Ball and Mr. W. Ball, about ten years. The ring of Saturn; Oh, what a mysterious affair. It is a *substantia singularis*, as Lord Bacon would say, in the solar system. Not merely is Saturn bent like Jupiter, and therefore the belts show the same curvature, but he is surrounded by a whole system of rings, and when the state of things under which those rings exist is carefully considered, it is found that they must be either liquid or else formed of a great number of small bodies, all floating together. The phenomena will agree quite as well as anything with a great liquid steam, which would be about the distance from the planet equal to two-thirds of the distance between the earth and the moon, and yet would be forty miles thick, sustained incessantly by the beautiful balance of forces as the stream goes around Saturn; for the satellites of Saturn and Jupiter, and our own moon, are always flung around so fast that they never fall, and Saturn is always kept inside, in the middle, by the agitation of his enormous satellites on the outside, very much as a balance of skill by slight agitations of the end of a rod will keep it constantly perpendicular. He could not have the ring a moment unless his satellites were on the outside—veritable satellites or guardians of his ring, so that he may not lose it. The next thing I shall speak of noticed by the telescope is the fixed stars, but before I quite do that, let us get an idea not merely of the size of the sun, but his distance. While the distance from here to the moon is a ten months' journey by steam, the distance from here to the sun is more

than 300 years' journey by steam at thirty miles an hour; so that if you had started with Fernando Cortez, when he began the conquest with Mexico, you would just have got at the sun and had a comfortable residence established of about twenty-five years, going with the velocity of steam all the while. And then to perform the enormous circuit around this great luminary, to fly around as we do every year! Oh, how fast must we go! I am not speaking of some fiction of the east, but I am speaking of sober fact, when I say we go eighteen miles every second we live. Yes, while I deliberately say to you, "It moves, yes, it moves," we have gone forty miles. Then the most remote planets are thirty times farther off, and our nearest neighbor among the fixed stars is 7,000 times that. When we come to distances as great as that, we need another unit with which to measure them. A mile is good for nothing in measuring such enormous distances, and, therefore, to illustrate, we must make use of the velocity of light, which I spoke of in the beginning of the lecture. Light travels in a single second 250 times as far as a locomotive would go in a day, and when I tell you that, what I just said is proved. Now, this being so, remember it, and remember that it would take eight and three-quarter months to travel with the velocity of light from here to the sun, and it does when the sun's light reaches you, and then from our nearest neighbor among the fixed stars, the time occupied at that prodigious rate is three and one quarter years, and other well known stars are thirty, forty, seventy, and more than 100 years distant by the velocity of light, and that the outer parts of the system we see with our bare eye are at least ten times as far off as that. With the large reflecting telescope, I cannot stop to describe it, of Sir William Herschel, we have gone seventy-five times that again, and that far beyond there seemed to be cloudy looking spots, which might be removed 700 times as far off; there are yet stars like those we see. I have tried to tell you where the fixed stars are. Now, what are they? Do they shine to us by reflected light? If they shine by reflected light, where, oh, where are the far more enormous bodies that illuminate them, and why don't we see them? But, what is more, the light of some of them has been measured in a reasonable way, and one of them seems to be as bright as at least 100 suns, or, as some of the results say, 225 suns. Therefore, if you will not call them suns, please invent some grander, nobler term by which to describe them. A light exceeding the brightness of the sun is the last figure we can make use of, almost,

in the way of intensity. What, then, shall we say of bodies that give us the light of 100 suns at once? What shall we call them? But, if you will not insist upon a new name, then, indeed, the stars are suns, and the analysis of the spectroscope brings to light new phenomena which insist again that stars are suns. But, what a simple declaration! Four words are enough to describe it, but, oh, what does it mean? It means that the tiny ray which gladdens our eye, as shot from some twinkling star, it trembles in the casement, is a miniature sunbeam; and the faint and feeble glow which sometimes, like a tiny transparent veil, covers the fair face of nature, is itself woven of the scattered glory of thousands of suns. And yet it is only starlight after all! How awful must be their distance! Some of these bodies are so remote that the light which left them started before the human race began, before God in sublime self-counsel said: "Let us make man, and breathe into his nostrils the breath of life," and man became a living soul. Oh! long before that came the light which is scrutinized by the telescope of to-day from some of those bodies, and I am seeing it as actually as I see your faces. Oh! what a little bit of the record of past eternity is unrolled to be read in time. If this be so, what would happen if we could look from the other end? Could we be away back there and look down here we might see, if we had sufficient power and skill, a visible record of much, or very much of all that has taken place here. How interesting to think that the visible record of what took place in old geological times, flying far up, has not yet quite reached the sun regions, even with the full velocity of light, may yet be read. The author of a little work called "The Stars and the Earth" has brought out that idea very beautifully, and carried it just as far as it will bear; and it is all beautifully presented. But not a bit of it, when he takes a single step further and says: "Thus we may get some idea of the might of the Divine Omniscience." Poor man! Such a fact give an idea of the Divine Omniscience! Is not the fact immensely more infinite than any mere visible indication of it? And does it give the first blush of an idea of the enormous penetrating omniscience which extends down to the roots of character, away down in the mind of the man, and knows what he is going to do, what he is going to think, and extends far off, and is acquainted with all our ways. Oh, no; it does not give the first blush of an idea. Now I come to notice another interesting matter in regard to the fixed stars. They occur in pairs all through the heavens, two and two. Now it sometimes happens, and it might very reasonably, indeed, that one is right behind the other. But if

this should take place all over the sky, that stars should be seen two by two, that would not seem to be the result of the merest collocation. Accordingly, sometime before he died, Sir William Herschel, the trumpeter in the Hungarian Guards, who afterwards "wrote his name in the heavens," as has been said, the illustrious astronomer and remarkable as a man—noticed this curious arrangement. He also began to notice whether the times of stars were changed, hoping that generations after him would make out something with regard to them. In forty-six years, or so, one of these circuits was accomplished. So in a great many other instances. They turn around one another, or rather around a common point between them, sun around sun, and form a constellation like a planet and its satellites. We can see very much of them, but the spectroscope is going to tell more, probably. What is very, very beautiful, is that they appear colored, often. A star, which seen by the bare eye is white, when scrutinized with the telescope is made of rose color, or green. One of the most beautiful objects in the heavens is two stars, one yellow, the other blue; but to the naked eye, by a proper mingling of the colors, they all appear white. Oh, why this beautiful arrangement? I can only ask the question at the present time. The greatest poetic imagination almost ever exercised, that of Milton, never conceived anything more sublimely magnificent in the instruction of the Angel to Adam than is found in these dainty scenes, these parti-colored gems in the coronet that surrounds the dark brow of night. Now this comixture of colors makes white light. And here comes in a difficulty, and a neat artistic mode of overcoming it in the telescope I have spoken of. When the light passes through the edge of the object glass, the white light is separated into seven different colors, more or less. If, however, you take a second glass, concave or convex, and made of a heavier and denser glass, you need not make this one undo the convergency of the other; it will only partially prevent the rays of light coming together, not let them come together so soon; but it will take hold of the colored light, the light which was the most bent, the violet, it will throw it back upon the light which was the least bent, and thus the angle of all will produce white light. That is the colorless, the acromatic prism introduced by Peter Dollond about the middle of the last century. Now, to produce a combined object-glass which will be exactly that, is a matter of far greater difficulty and expense than you can possibly, at first, judge of properly. In the first place, there must be two pieces of glass, each as pure as the clearest jelly, so you can almost look

through them. You have seen the representatives of the different large sized diamonds in the windows of the shops, and sometimes how beautiful they look, each being formed of an exquisitely pure little bit of glass. Now, to form only one of these discs every part must be as pure as that, and no one part of it must be more dense than another. The mixture of the thing must be so accurate throughout, it will be, as if you propose to your cook the problem of making a cake from a given receipt, every crumb of which when analyzed by the chemist should be found to be combined in the same nice way. No wonder, then, that a mere disc of glass two feet in diameter or more is the very last stretch of art at the present time, and that the mere material of two such discs is worth in itself $3,500 in gold. Then, when that is produced, you must shape the four surfaces accurately, making the one destroy the color of the other with rigid accuracy. That in a large telescope may be the work of two years before it is accomplished. And yet that very difficult work is doing and has been done. A few years ago a telescope with an aperture of nine inches was the last result of the effort of art; but they have got up to a foot and fifteen inches; and Mr. Fitch, whose loss you have deplored here in New York, was wonderfully successful in making these achromatic object glasses. Spencer, also, and Eaton, and lastly Alvah Clark. We have among us in America one of the best opticians in the world, Alvah Clark. He is just as modest and unassuming as he is worthy; and when I use the last epithet to enhance the others, I say a very great deal. And I say Princeton College honored herself when she gave him an A. M. not long ago. While that large telescope, which is in use in Chicago, was getting ready, and before anybody had bought it, this persevering, modest man turned his eye toward the heavens and discovered the body that had disturbed the motions of Sirius, and the French Academy therefore very properly gave him the gold medal for the best astronomical discovery of the year. Then, not only has the telescope done this, but it has pictured things by the aid of photography. The photograph of the moon by Rutherford, of New York, is one of the largest ever produced. Prof. Henry Draper, of New York University, as I have said, has done the same thing. More than that, photography has been brought in in a new and very curious way. You have heard how long light is in coming from the stars. Starting from one of those double stars, the sharp-pointed, straight-traveling pencil of a little beam, years in coming, disturbs the little molecular arrangement of a plate well prepared by the chemist, and writes

down, beautifully and accurately, the position of those two stars, so that they can afterward be measured. Oh! what a beautiful instance of the coöperation of the sciences in this our day! One of the beautiful features of modern science is this harmonious coöperation of one branch with the other, so that when an optician produces a good telescope and analyzes a light, and then with his prism discerns its colors, the chemist takes it into his laboratory and finds that he can make out the composition of remote bodies by means of it; and the astronomer takes it back and asks the question of the different bodies—the suns and stars—whether they are made of the same material with things in the laboratory, and the answer comes back, yes! Iron, magnesium, and other materials, all have existed far, far off, and so one branch of science incessantly coöperates with the other. But I tire your patience. [Cries of "Go on."] [The lecturer here presented a diagram representing astronomical appearances which resembled a revolving rocket.] When I came to investigate these things in the year 1851, it struck me that here were enormous flattened spheriods, which, by turning them too fast, had had the material scattered after the fashion of a whirling rocket. When the whole thing was more carefully examined, it seemed perfectly supposable; and when one curious form after another was explicable, shall I tell you I almost held my breath, as I said, standing afar off in awe and humility. Oh, may we thus discern the way of the great Creator, far back in the eternal past. How long have thus been produced, by the rending and dispersing of useless masses, worlds that produce life and light wherever they go? On what a scale must these things be carried on, when, in the rending and tearing, every drop is a sun, and when those suns are kept out of each other's way, and are scattered to bear their own planets (at least in our own case) safely out of the reach of others! But under circumstances like these, how will you do without a Prescience and a Providence? In this great department of knowledge, as well as everywhere else and always, a sound philosophy is wanted; and nothing else is wise enough, powerful enough, enduring enough or good enough—nothing else than the living God, the everlasting King of a very old-fashioned Book. This is the great, the final hypothesis—a hypothesis broad as the Universe which God sustains and pervades by His power, lasting as the Eternity which He, the always Ancient One, inhabiteth; and an hypothesis in the light of which that justly accepted principle of the uniformity of causation meets this sublime paraphrase. Science is practicable, aye, Science exists because God is true.

SCIENTIFIC LECTURE.—III.

ON THE BAROMETER.

By Professor Guyot, of Princeton College.

Judge Chas. P. Daly presided at the lecture delivered on the evening of December 11, 1868, and, after alluding to the lecturer's eminent scientific attainments, especially as in physical geography, said it afforded him great pleasure to introduce the distinguished gentleman to the audience.

Professor Guyot said: Our earth is composed of various elements, as they are called—the solid, the liquid, and the gaseous; three different states of matter, which have very different functions in the whole system of the globe considered as one individual. On the solid land, as you are aware, are found by far the highest forms of life, whether plants or animals. It is in the solid ground, also, that man produces, developes, civilizes; and there alone he can find all the elements for his work. In the water, which covers three-fourths of the whole area of the globe, are found organisms which are quite of a lower grade; and it is therefore in this sense a lower element. Nevertheless, you know how perfectly indispensable it is for the life of the higher. The third, the gaseous, which surrounds both, seems to be equally necessary for both. Both animals and plants, high and low, all need the atmosphere to give them power, and motion, and movement; and it is from the most impalpable of all the parts of our globe that we derive the motive power. The combustion which takes place within us by respiration gives us animal heat—also necessary for motion. We see, therefore, that this envelope which is outside our globe, is by no means unimportant; though it does not furnish the material elements necessary for our bodies, it furnishes the power for animating the whole. It is with this atmosphere that we have to do this evening; it is the grand receptacle of all the physical influences which flow from the outside and the inside of our globe, and which are the conditions or modify to a great extent the life of organized beings. Hence the vast

importance of all that refers to the atmosphere. Under the term "climate" we include the heat of the atmosphere, the amount of water which it usually contains in the shape of invisible vapor, and last of all, the weight or density of the atmosphere. These are the three great elements of investigation which we have to consider in the discussion of climate. But our subject is pre-eminently (though it cannot be entirely) confined to the investigation of the weight of the atmosphere by means of the instrument which we now see before us—the barometer. The atmosphere is a very simple garment around the earth, and a very thin one. Its total height, as far as it can be estimated is no more than forty-five miles; and, owing to its extreme compressibility, three or four miles of the atmosphere, that is above the level of the sea, contains more than half the total weight; and it is in that very thin layer that the whole of the life of the globe is found and performs its functions; and what is very important, after all, in this large globe of ours, is what is going on within that very thin cuticle of atmosphere. It is very important to see what is taking place in that part, and we come now to the subject of the barometer. This word means " an instrument to measure weight "—two Greek words signifying to measure weight—but until the seventeenth century it was scarcely believed, except by a few select minds, that the atmosphere, which is composed of repellant atoms, could be weighed at all. Aristotle tried whether there was any weight in it, but his experiment, not being well managed, gave no result, and until the 17th century it was thought, though nature has a horror of a vacuum, the air had no weight at all. It is due to Galileo to mention that he discovered the fact that air has weight; by this means he explained the circumstance that water will not rise in wells beyond a certain limit, and explained the phenomena of suction; and he was in the midst of those experiments when, old and broken down by persecution, he died. He left it to Torricelli to discover the barometer. He thought of a simple experiment to demonstrate the weight of the atmosphere. He thought at first of filling a tube with water; but afterwards he filled a tube with mercury (which is thirteen and a-half times heavier than water) and then turning this tube into a cup of mercury, lo! it was found that the mercury would not sink down out of the tube, but that it stopped at about thirty inches above the level of the sea—and then was the barometer invented. The whole weight of the atmosphere would be expressed by the column of

mercury. We find here, therefore, that original instrument was very simple, and yet it demonstrated to all eyes that the air has weight, and that it could give the measure of that weight. The value or weight of the column of mercury (if you supposed the surface exposed to be about one square inch) gives about fifteen pounds to the square inch as the weight of the atmosphere. This, therefore, is the original instrument which afterwards was modified into the form here represented. All these contrivances are simply to measure the difference between the surface outside the column and the surface at the top of the column. (The Professor here pointed to the diagrams of the various forms of the barometer, and gave explanations in regard to the construction of each.) Of late years there have been introduced into this country a number of what are called "Aneroid Barometers." The name indicates what the instrument purports to be. It is a box which is supposed to be void of air, and therefore very sensitive to the pressure of the atmosphere; as the pressure of the atmosphere increases the box becomes flatter; but as the pressure becomes less the box expands again. This motion is shown by means of an index. No mercury is used, but merely a metal box. Another form of barometer is a double band of metal; it uncoils when the pressure increases, and coils as it is removed, and, therefore, by means of a hand, it indicates the weight of the air. This instrument is also very sensitive, and would be excellent if the expansion of the metal were not a constantly changing element. We are never sure of what we are doing with an instrument of this kind. The variations between one and another of these instruments are very great; every instrument must be tested for itself, both for temperature and otherwise. The general correction for the reading of the common barometer, which must be made for the expansion of the mercury, is about the 3,000th of an inch for every degree of temperature, but this cannot be applied here, and that is the great difficulty with the Aneroid barometer. And besides, it may be deranged by a simple knock, or by being exposed to a great and sudden change of temperature. And it does not tell you that it is out of order, as the other form of barometer does. You see at once when the mercurial barometer is out of order; and here you cannot see. It wants to be constantly checked by the mercurial barometer, and therefore it is not an independent instrument. I carried one of them to the top of Mount Washington, but I found it nearly useless; in fact I have discarded them altogether. The Aneroid is excellent at home, in the street; but it is a bad traveler. Now, how shall we

use our instrument to weigh the atmosphere? If the atmosphere would always be in its normal condition, why should its weight vary? Why should not the column of mercury in the barometer always show the same height? In order to understand the variations, we can't dispense with entering somewhat into the general laws which govern the atmosphere, not only its weight, but the influences which disturb its equilibrium. We must know what are the conditions of the equilibrium of the atmosphere, and we must find the forces which interfere with that equilibrium, and which cause, therefore, the variations of the barometer. These variations which I have now to explain, may be classified in a general way, by saying that we have "regular variations" and "irregular variations." There are great atmospheric tides each day, each month, and each year almost. These atmospheric tides are constant in their operation, though they are not the same in all latitudes. Every day there is a vast tidal wave of the atmosphere; it is found in all regions of the globe, south and north, to sixty degrees of latitude; beyond that it is not very marked. Every day the barometer, after discarding all the irregularities, and, by means of a long series of observations, taking the averages, rises and falls regularly like a tide. You will find that it will stand highest in the morning at about 9 o'clock. On an average, the lowest point of the twenty-four hours is at 4 o'clock in the afternoon. It rises again during the evening, until 10 o'clock at night; then it sinks until it reaches the minimum; then it rises again the next morning until 9 o'clock. It is a constant tidal wave, repeated twice in every twenty-four hours. The difference between the maximum and minimum is not very great; it amounts only to the 200th of an inch; in our latitude, indeed, less than that, but it increases towards the tropical regions, and about the tropics and on the equator you have the greatest amount of tidal wave; and it amounts then from the 200th to the 300th of an inch. This rise and fall are so clearly and specially remarkable that Humboldt said, while traveling in South America, that he could tell what time of the day it was by looking at the heighth of the barometer. It was a regular clock. Now you see this is a kind of variation, the character of which is to increase towards the tropical regions, or as the heat increases and decreases towards the cold. The regular variation with the months is of a similar character. In summer months the barometer is generally lower than during the winter, and, on an average, it is lower in all the warm regions of the globe, than

it is in those that are colder. It is always lower, too, in rainy seasons than in dry. Besides these there are annual variations, and these are very small, about a few hundreths of the tenth of an inch, therefore, they are not yet considered within the perfectly well defined variations of the great tides. The others are real tidal waves. I will now speak of the "irregular variations," which are by far the most conspicuous that we are acquainted with in this latitude. The barometer is falling and rising all the time. Its stationary condition is a very rare thing. If you could have a barometer made of water, a tube filled with water, which should be thirty-three and a half feet long, it would greatly magnify these perturbations, and it would not be seen quiet scarcely for a moment. There would be no such thing as a calm; its normal condition would be motion. We find this in all barometers in these latitudes, but in the tropics there are scarcely any irregular movements; hence it is that in those regions you can operate with the barometer with scarcely any corrections; but the further you go north, the greater the differences between the extremes. What does this indicate, but the fact that the atmosphere in the extra tropical regions is in constant state of movement and agitation, which causes these immense differences. The lecturer then went on to explain the causes of these differences. The rarefaction of the atmosphere by heat causing immense upward movements, succeeded by a down rush of denser air; the quantities of moisture taken up into the atmosphere; the diurnal movement of the globe causing modification in the direction of the currents of air, &c. He gave interesting facts in regard to cyclones, the movement of storms, and the uses of telegraphy in averting to some extent the damages by hurricanes.

The lecture of which we present only a condensed report, was highly interesting, and was listened to throughout with marked attention.

SCIENTIFIC LECTURE.—IV.

PHILOSOPHY OF THE TEA-KETTLE.

By Prof. Benjamin Silliman, of New Haven, Ct.

The fourth weekly lecture of the course was delivered Wednesday evening, December 16, 1868, before the American Institute, at Steinway Hall, by Prof. Silliman, of Yale College. Judge Daly, Vice-President of the Institute, introduced the lecturer to the audience in a few appropriate remarks.

Prof. Silliman said I feel much hesitation, and no little diffidence in my own power, after such a flattering introduction as your worthy President has given me here, and possibly some of the ladies may have occasion to laugh at the exposition of the principles of philosophy by means of a tea-kettle. My theme, as you will observe, is introduced to you by a very homely title, but I trust before we are done with it, you will have an opportunity to see that it covers a pretty wide scope of human knowledge, and that there has grown out of its study one of the most signal of all the great steps which mankind has made in the arts of life, and in all the progress of this progressive age. Some of you may have seen a beautiful picture which was painted some twenty years ago, by an English artist, in which a beautiful boy, apparently ten or twelve years of age, is kneeling on a chair with his finger placed on the lid of a tea-kettle, while his eye is obviously wholly engrossed by the phenomenon which are taking place before him, and his mind completely so, and he does not heed the presence of a stately lady, dressed in the costume of a hundred years ago, who, holding a watch before him, says: "Do you know that it is a whole hour that you have been here in this listless way, holding the saucers and the spoons in the steam that is coming out of the spout of that tea-kettle, and counting the drops of the water that has fallen from them, when you might be engaged in some useful occupation?" This lad was James Watt, the distinguished

discoverer of the steam engine. When administering to him what she doubtless thought was a well deserved rebuke, little did she understand the thoughts moving in that great brain and little frame; for Watt, you must recollect, was a puny child, with a physical development which gave no promise whatever of his great intellectual capacity and wonderful achievements. Little did he dream that in those studies of the philosophy of the tea-kettle in which he was then so intently engaged, was wound up, as the butterfly in his cocoon, the embryo of the greatest discovery of modern times. Let us then enter more in detail to the consideration of the arts brought to light within the 100 years which have elapsed; for you must remember that January, 1869, will be exactly a century since the time of the contract between James Watt and Boulton of Soho, by which one undertook to furnish the brains and the other the capital, and which resulted in the introduction of the steam engines into general use. [Prof. Silliman here illustrated this branch of his subject by showing the effect of the Bunsen gas-burner in producing heat and vapor. He explained why it was necessary to apply heat to the bottom of a vessel to heat water to the boiling point; that where heat was so applied it produced an upward current through the whole water. Heat applied to the top of the water would not make it boil. After some remarks upon the phenomenon of heat, while the water in the vessel was gradually rising in temperature, he said: This vessel which we are heating has now become filled with bubbles. Fishes breathe water because it contains atmospheric air, while it is richer in oxygen than common air. The first phenomenon therefore in seeing that kettle boil is the displacement of the air. Tasting water that has been boiled, after the air has been expelled, and before the air has time to return, it is flat and unpalatable. The tea-kettle is boiling under the pressure of the atmosphere. Every individual carries a ton weight in the pressure of the atmosphere upon his person. Ordinarily we do not feel it; but in walking on the surface of miry clay we feel it, because then the upward pressure on the soles of our feet is removed. The second condition we have to consider, then, in the boiling in the tea-kettle, is that we are boiling the water under the pressure of fifteen pounds to the square inch. Boiling is not always necessarily connected with temperature. If the pressure of the atmosphere is taken off, in whole or in part, there may be ebullition without great heat. [Water at 120 deg. was here boiled in the air pumps.] Boiling consists simply of little

bubbles of vapor rising and escaping from the surface of the fluid. An egg might be boiled all day in water at 120 deg. without being cooked, because it requires a greater heat to cook it. As these little bubbles rise in the tea-kettle, they strike a colder stratum of water and are condensed, the water falling to fill the vacuum, producing the sound we call the singing of the tea-kettle. The next stage of our process of boiling will be the process of distillation, which consists in the transfer of particles of water out of the liquid state into vapor, then its translation and final recondensation in another place. [Prof. S. here illustrated the process of distillation.] The amount of heat passing into the water in the tea-kettle would be measured by the thermometer until it reached 212 deg. At that point the thermometer would cease to rise, although the heat was still passing as rapidly as before into the water, the surplus being employed in converting the water into steam, which escapes from the vessel. Having heated water in a glass vessel to the boiling point, we remove the fire and cork it up. It continues to boil; and upon pouring cold water upon the surface, it boils still more violently. Why? Because the condensation of the steam removes the pressure, and the water boils more readily, even at a lower temperature. [He proceeded to try Count Rumford's experiment, of building a hot fire, with a temperature of not less than 2,000 deg. above a vessel of water.] The surface of the water boiled, as shown by its condensation upon a cold glass plate laid above it; but the water in the vessel was not heated. It is necessary, therefore, to heat the tea-kettle at the bottom, and not at the top. If we desire to boil substances which will be injured by the temperature of 212 deg., we may readily boil them at any lower temperature, above 100 deg., by removing the pressure of the atmosphere. Taking equal quantities, by weight, of ice at 32 deg., and boiling water at 212 deg., the ice was melted by the water, and the temperature of the mixture was 52 deg. There had disappeared 140 deg. of heat, and this was the latent heat, without which the water would remain ice. Every one has noticed that the melting of ice in spring causes a great chill in the atmosphere; for whenever and wherever ice is melted, it absorbs inevitably 140 deg. of heat. On the other hand, the vaporization of water takes up a great deal of heat, which is rendered latent; for steam itself, at the pressure of the atmosphere, has only a temperature of 212 deg. If we measure the heat thus becoming latent, we shall find that it amounts to about 970 deg. By adding constantly a given quantity of heat, we shall find that it takes

five and a-half times as long to convert a given quantity of water into steam as to raise it from 32 deg. to 212 deg. This latent heat would be enough to heat water, if a solid, red hot. If we add to the pressure of the atmosphere, we shall have a higher temperature of the steam; but the amount of latent heat in the steam will be less, the sum of the latent and the sensible heat being a constant quantity, equal to 1,180 deg. Fahrenheit. The conversion of water into steam will expand it into 1,700 times its former bulk, and this exerts a prodigious amount of mechanical force which is utilized in the steam engine. Heat is nothing but a mode of motion; and the steam engine enables us to make that motion useful in the form of mechanical power. [He illustrated the reconversion of motion into heat by rapidly turning a brass tube containing ether and corked up, and holding around it a wooden clamp until sufficient heat was generated to convert the ether into vapor and blow the cork from the tube.] Count Rumford, in the latter part of the last century, tried a similar experiment upon a much larger scale. When in the employment of the Bavarian government at Munich, he made those remarkable experiments which have signalized his name in this department of knowledge, for he employed horse power in the boring of cannon held in a vessel of water at the ordinary temperature, noting the time occupied, and the amount of force supplied. In about two hours and twenty minutes he brought this large body of water into a state of ebullition, simply by the mechanical power applied in boring; and experiments have since demonstrated that in order to raise a pound of water through one degree of Fahrenheit, there must be sufficient power applied to raise one pound to the height of 772 feet. This is what is called the mechanical equivalent of heat. [Prof. S. next treated heated water in a closed spherical vessel connected with a column of mercury and a thermometer. When the pressure of the steam had forced the mercury to the height of thirty-three inches, corresponding to a pressure a little more than twice that of the atmosphere, the thermometer had risen to 245 degs. He then opened a tube to allow the steam to escape into a vessel of water, at first producing a rattling sound in consequence of the condensation of the steam by the water, and the falling of the water to fill the space thus left vacant; but very soon the water was raised to the boiling point, and then the rattling ceased, and the steam passed noiselessly through the water and escaped.] It is easy to convey heat in the form of steam; and it is now common to convey it in pipes sometimes for

long distances to wooden vessels, where it is desired to boil water. Steam is the most wonderful vehicle for transporting heat with which we are acquainted. This hall is heated by steam from a boiler in the cellar, giving us 1,000 degrees of heat, the latent heat of the steam becoming sensible as it is condensed in the pipes, and with such astonishing rapidity that it sufficiently warms the atmosphere of the room, furnishing one of the most efficient means of heating which is known. Heating either by hot water or by steam, the relative merits of which I am not now discussing, is by far the most economical, the most efficient, and the most agreeable of all artificial means. [Prof. S. then exhibited a toy steam engine, rated at two-mouse power [laughter], proceeded to give an explanation of the steam engine as invented by Watt.] The first step of improvement was to close the cylinder at the upper end; hitherto it had been open. In the former steam-engine the steam had forced up the piston, and upon the condensation of the air in the piston by cold the atmospherical pressure brought it back again. Watt had introduced other improvements, among which were the indicator, the governor, and the cut-off. There has never been in the history of inventions since the world began any machine or apparatus which was so perfect as it left the hands of the inventor as the steam-engine was when it left the hands of Watt. You may stand to-day beside the most stupendous piece of steam engineering in the world, and you will see connected with it no essential change from his invention. It is true that he had no machinery or tools competent to reach the exact results that we can now produce. He had no turning-lathes, boring machines, planing machines, but all was done by a cold chisel, the hammer, the file, &c.; and the marvel is that he produced such results as he did. I have often thought with what delight that great man would stand upon one of our first-class steam frigates, or by one of our first-class pumping engines, such as is used at the reservoirs in Brooklyn and New York, and see the perfection, the finish, and the smoothness of the work, a result possibly solely due to the genius of Watt, because without that power we could not have had the apparatus with which to apply it. [Prof. S. next proceeded to illustrate the irregular expansion of water near the freezing point. He filled a vessel with water at 55 deg., and surrounded it with ice and salt to reduce its temperature.] A freezing mixture is composed of two solids having an affinity for each other, but which cannot unite without becoming fluid; and in order to become fluid a large amount of latent heat is required,

which must be borrowed from the surrounding substances. In the vessel of water he immersed two thermometers, one near the top and the other near the bottom. As the temperature of the water fell, the lower thermometer descended to 39½ deg., and there remained stationary, while the upper thermometer continued to fall, and at last reached the freezing point. Why does not that system of currents keep going on like the boiling of water in a flask, so that the whole shall freeze at the same time? That is just where this wonderful exception takes place, and it is the great delight of a devoted mind to believe that the exception is a part of the original intention of the Great Architect in the formation of the world in adapting it to be inhabited by human beings, because we may readily believe that, except for this irregularity in the exception of water the world would be uninhabitable. At the temperature of 39½ degrees the very contrary effect takes place, and the water begins to expand, it increases in bulk, and consequently becomes specifically lighter, and, like a cork, floats upon the surface, or immediately beneath it; so that you will have the surface of the water cooled down to 32 degrees, and converted into ice, and yet that freezing does not extend much below the surface. You rarely find, in the coldest winter, that ice is formed more than two feet thick. If you observe a caldron of molten iron as it cools does it solidify first on the top? No. Does a mass of lead in a ladle solidify at the top? No; but equally at the bottom. In most cases the solid, which is the result of congealation, is heavier than the fluid in which it is formed and sinks to the bottom, wherein in the case of the water the solid is much lighter than water. We have here another exception that the ice which is formed is lighter than the water and it floats upon it. When we see an iceberg from 100 to 200 feet above the surface of the sea we know that for every foot of elevation above water there are ten feet of depression beneath the surface; so that what we see is only one-eleventh of the whole bulk. Lake Superior has a uniform temperature of about forty degrees, and beneath the surface, in the winter, in any of our lakes we shall find water at about that temperature. This is an important fact with reference to the inhabitability of our globe; because, you observe, that if water as it solidified continued to shrink and to become heavier, the whole mass would become frozen in a single winter so that no summer would be long enough to melt it, and eternal death would rest upon the surface of the globe. [In the freezing mixture Professor Silliman inserted one

end of a closed tube, containing vapor, and containing water in a bulb at the upper end, and the condensation of the vapor, from the abstraction of the heat by the freezing mixture, in its turn abstracted the heat from the water in the bulb above so rapidly that it was frozen solid. He then illustrated the heating of houses by hot water pipes, showing that the heated water would rise from its being lighter than that not heated, and thus a circulation of water never heated above the boiling point, and therefore not liable to burn the atmosphere by charring particles of dust in it, would be constantly maintained. He proceeded to speak of the chemical constituents of water, being two atoms of hydrogen and one of oxygen. [These two gases, which have never been reduced to liquid form by mechanical power, would readily unite by the magical power of chemical combination, and form that wonderful matter which we call water. The ancients, in their philosophy, said the earth is composed of four elements, earth, water, air and fire. We may interpret this under the light of modern science thus: Earth is the solid, water is the liquid, air is the gaseous condition of matter, and fire is the force that converts them all from one condition into the other. We have in water the solid ice, solid and permanent as granite, so long as the temperature is unchanged. We have in water an inelastic, mobile, transparent fluid. We have in water the perfectly elastic invisible gas which we call steam. Although we cannot, by mechanical means, compress the gases which constitute water into liquids or solids, yet by their union we can condense them into water; and we can, by their union, produce the highest degree of artificial heat which it is in the power of man to produce mechanically. [Two vessels, one containing hydrogen and the other oxygen gas, were connected with a single tube. The former, being turned and lighted, produced an ordinary flame (the gas not being pure), but, upon turning on the oxygen gas, the two produced a much whiter and more brilliant light. Placing in the blaze a mass of cold iron, the water produced by the union of the gases was condensed upon its surface, falling from it in drops. He next placed in the blaze a slender bar of steel, and the heat was so great as to burn the steel, scattering it in a shower of intensely brilliant sparks.] (Applause.) These two elements, by their collision, produce an amount of heat, as a mode of motion, which is beyond that which we can produce by any other artificial means, which is purely mechanical. We can, indeed, by this voltaic circuit, acting chemically, produce a current of electricity,

in the focus of which everything which can be melted melts, and everything that melts volatilizes. That, as I have said, is a mode of motion. It can be converted into motion, and motion in like manner can be converted into heat. We are living upon a ball of matter moving through space with planetary velocity, and if that mechanical motion with which the earth is moving in its orbit could be suddenly arrested the amount of heat which would be equivalent to that mechanical motion would not only be sufficient to melt the whole earth, but to actually volatilize it into the nebulous state again; nay, it would be sufficient to volatilize six worlds as large as that which we occupy. I am prepared to show you some wonderful experiments with the spheroidal condition, but I have not time, and I will close this already too long lecture with a single illustration more. There is an erroneous idea that steam boiler explosions are produced by the formation of a certain gas. The only gas is steam, and it is only because there is too much steam. There is often too much steam because there is too little water; and also owing to the fact that when water comes into contact with superheated surfaces of iron it is suddenly converted with great violence into steam, sufficiently powerful to tear the strongest metals. Chemists utterly deny that there is any foundation whatever for the popular notion among certain mechanics that there is produced, in cases of explosions of steam boilers, a kind of gas. There is power enough produced by the union of these gases, oxygen and hydrogen, to produce all the effects which have been witnessed. [At this moment a mixture of oxygen and hydrogen gas in the proper proportions in a mortar was exploded, producing a loud report.] There is the sort of gas that produces explosions, and it is the result of the reunion and collision of the elements of water. These are a few of the ideas which are connected with the philosophy of the tea-kettle. [Applause.]

The lecture of Prof. Silliman was illustrated by a great variety of experiments, many of which were received with much applause.

SCIENTIFIC LECTURE.—V.

ON THE PRIMEVAL FLORA.

By J. W. Dawson, Principal of McGill College, Montreal.

The fifth lecture of the course of scientific lectures before the American Institute, was delivered by Principal Dawson, of the McGill College of Montreal, last evening, and was illustrated by a series of charts representing the vegetation in the periods of the earth's history before the creation of man, as revealed by their fossil remains.

Principal Dawson said: An eminent authority has defined geologists to be a class of amiable and harmless enthusiasts, who are happy and grateful if you will only consent to give them an unlimited quantity of that which, to others, is perhaps the least valuable of all things, namely, past time. I confess to this definition of geologists, so far as my subject this evening is concerned, for I shall have to make a large demand upon your faith as to the extent of the past time, and shall have to ask you to give me all of it which you reasonably and conscientiously may. Geology, indeed, works strange revolutions in our view of things new and old. The primitive forests, and even the gray rocks and hills themselves are things not primitive and unchanging, but things, comparatively of yesterday, the successors of olden forests and olden rocks that in dim and ghost-like procession recede from our view into the past of antiquity, compared with which all human antiquities are things of yesterday. "The murmuring pines, and the hemlock, bearded with moss and in garments green, indistinct in the twilight," may "stand like Druids of old with voices sad and prophetic," but they belong not to the forest primeval of the earth's younger days, though they may point backward to perished predecessors of truly old date, truly primitive and geological antiquity. It is to them that I must try to carry you back in imagination this evening, to awaken those slumbering ages and make them green again in your eyes and vocal in your ears. Transferring our thoughts to these old forests, and imagining their

strange fantastic forms, and the singular creatures that lived beneath their shade, we shall find ourselves in a new world different from that which we inhabit, and differently peopled. Could we marshal in one view four or five planets, each clothed with the peculiar flora, and inhabited by the peculiar fauna of a distinct geologic period, we should truly have before us many distinct worlds with nothing to connect them with each other save only certain similarities of plan and conception. But when we view these several worlds as successive, and destined the one to prepare the way for the other, we can perceive relations of the most remarkable and unexpected character, and have presented to us a long protracted scheme of creation too vast to be contained on the surface of our planet at any one period, and representing with our present flora all the possibilities of vegetable existence, and all the uses, present and past, which plants can serve. I have selected as the subject of this lecture one small department of the vast field of fossil plants, a department of peculiar interest as relating to the oldest known plants, and which, as a special and favorite study of my own I must endeavor to make attractive to you. But I must not rest contented with this, but in justice to the subject must try also to present it in an orderly and systematic manner. I must endeavor to give you something like a connected sketch of that primeval flora which is the subject of this lecture; and in order to do this, I must first say a few words on the relations of these early forests to existing plants; 2d, I shall say something of their relations to geologic time; 3d, I shall enter upon the subject proper by describing to you some of the more remarkable plants that flourished in that primeval age; and 4th, I shall conclude with noticing some of the uses of this primeval flora to us; and I shall endeavor to give you, if possible, some idea of the light which geology gives us as to the first appearance of plants on our planet, and how far back they can be traced in geologic time. First, then, I shall speak for the benefit of those who may not have pursued the study of botany, of the relations of existing plants, and the relation of the fossil flora to them. Taking the whole of the plants known to us, we shall find upon examination that they may all be divided into two great series; first, that series of plants in which we observe distinct flowers, and fruit containing seeds proper, seeds with the embryo of future plants. These are the highest plants, and constitute the Phænogamous plants of the botanist. Then we have a great group of plants of a lower and humbler organization, which are destitute of true flowers, and which instead of pro-

ducing seeds, produce little microscope spores. These are the Cryptogamous plants of the botanist. The whole vegetable kingdom is divided into these two great classes. Now, taking first the Phænogams, we shall find three classes of them. We have, first, that group of plants to which all our trees and shrubs and the greater part of our cultivated plants and weeds belong—the Exogens, which have a distinct pith, and wood, and bark. This is the highest group, the Exogens. Then we have a class in which there is no distinction of wood and bark, represented in the tropical regions by the palms, and in our climate by the grasses. These are the Endogens. And lastly, we have a class in which the pith, bark, and wood are all composed of similar material—the Gymnosperms, represented here by our pines, and in the tropical regions by the Cycads. Thus the Phænogams are divided into three groups, represented respectively by the oak or maple tree, the palm tree, and the pine tree. In the Cryptogams we may also make a threefold division—the Acrogens, or ferns and club-mosses; the Anophytes, or the common mosses, and the Thallophytes or lichens, fungi and seaweeds. Next let us see what relation the primeval flora bears to those of modern times. Two relations are possible. First, that the primeval flora may belong to a different classification altogether; and second, which is the true supposition, that the whole flora of the earth, from the earliest geologic times, comes under one classification. This shows that, from the beginning of geologic time, one plan has been followed out in the construction of the vegetable kingdom, and that the whole vegetable kingdom consists not of the plants now living upon the earth, but includes all the plants that have ever lived upon it. Again, there is another possibility, that the primitive flora may include representatives of all our modern classes of plants, or only some of them. The fact is, that it includes mainly representatives of some of them, and those of a medium grade, neither the lowest nor the highest, so far as the land flora are concerned. The fossil plants are not chiefly Exogens or Endogens, but Gymnosperms. On the other hand the Acrogens, or the highest group of the cryptogamous plants in our day were then the most abundant. The primeval flora therefore embraced the higher Cryptogams and the lower Phænogams. If we had known nothing of vegetation but that manifested by the primeval flora we should not have known the possibilities of the vegetable kingdom, either in its highest ranks or its lowest ranks, but only in the middle of the scale. Next let us glance at the relations

of the primeval flora to geologic time. The oldest rocks we know, the Eozoic, have afforded no plants, so far as we know, at all. The next series, the Paleozoic, include the oldest land plants we know. But in the Mesozoic period we arrive at a different flora, and in the Cainozoic, or modern period, we have other floras. It is the Paleozoic flora only of which I shall speak to-night. During the whole of the paleozoic period, the seaweeds have existed. In the earlier periods the classes of Acrogens and Gymnosperms far exceeded the Exogens and Endogens, while the reverse is the fact at the present day. The warm and moist climate of portions of the southern hemisphere at the present day now have a flora more nearly resembling the early epochs than any other portions of the earth. The uniformity of the flora of that early period indicates a temperature nearly uniform throughout the earth. At present we have in our atmosphere but a small quantity of carbonic acid gas. If we had more, it would tend to make the climate more uniform, by preventing the radiation of heat from the earth. The carbon locked up in our coal mines, and then existing in the atmosphere, may therefore have been at least one reason for the uniformity of climate on the earth in the paleozoic period, the flora of that day indicating a warm and moist climate.

Taking the Flora of the carboniferous period as typical of that, of the paleozoic in general, we find that there was a vast amount of vegetation, afterward made fossil and becoming coal. In that moist, warm, but unwholesome atmosphere, we find the Sigillaria or seal-tree, one of those most abundant in the swamps of the carboniferous period. Here we have a large, tall stalk, without branches, or perhaps divided into a few branches, covered with long leaves. We have remains showing the ribbed structure of the stalk, and the sears of the leaves. There are no trees in our latitude resembling it in structure. We know of the fruit of the Sigillaria only by the abundance of certain nuts, the *Trigonocarpa*, that are found around them. Trees of two and three feet in diameter were not uncommon. The root of this tree is more remarkable even than its stem, having attracted the attention of geologists before the stem, and obtained the name of Stigmaria. These roots are bifurcated and spread out in a remarkably regular way, all the little rootlets spreading as regularly as leaves. These roots occur very often in the coal formation without the stems, and at first it was supposed that they were the whole of the plant. The first process in the formation of a bed of coal, was usually the

growth of a forest of Sigillaria. The next class of plants is the Calamites. Some one called upon a botanist, said he had been shown his "calamities and felicities." These Calamites were the calamities. They seem to have grown on muddy flats along the margin of the Sigillarian woods, resembling Equiseta, or mare's tails, and they are still preserved in coal formations, in large numbers, in the erect position. The Calamites seemed to have preserved the Sigillarian forests from the effects of inundation, by causing the mud to settle before the waters passed into the forests. The Calamites thus contributed very much to the purity of our coal beds. The next plant is the Lepidodendron, or scale-tree, of a size equal to the Sigillaria, resembling our ground pines or club-mosses. This tree was more plentiful in the earlier coal formations than in later periods. (Other plants, also found in beds of coal, were described by Professor D., and drawings of them on a large scale were shown.) The plants of the carboniferous period would have presented to our eyes a very monotonous appearance; for it was characteristic of the flora of that period, that there was a large number of species but few genera, and these very uniform in their foliage. There were also some plants more familiar to our eyes. The ferns are to be found in the roofs of the coal beds, preserved as beautifully as they could have been preserved in a herbarium. They resembled more closely the ferns of New Zealand or the Hebrides, than the ferns with which we are familliar. Some of the tree ferns grew to the dignity and beauty of the palm tree itself. One genus, *Megaphyta*, was peculiar, having only two leaves at a time. We find, sometimes, in the coal beds things looking like enormous brooms, which are tree ferns, with roots sent out to strengthen the stems (Psaronius). We also find in the coal formation species of pine, the wood of which much resembled our modern pines. It is remarkable that the pine is very widely diffused at the present day, and it is not wonderful, therefore, that they should have existed in the carboniferous period. These pines have features more nearly resembling those of Australia and New Zealand, than those of our climate. When wood is buried in the earth, and its cells filled with water, holding silica or lime in solution, they become filled with stone and the wood becomes coal; and this is the form in which we find these fossil remains. By removing the mineral, we can observe the vegetable structure of the plants, and determine their character. Next to the soil on which we tread, the most valuable substance we have is mineral coal, which is derived from the plants of the carbon-

iferous period. A bed of coal is usually composed of the remains of the trunks and bark of Sigillaria trees. Examining coal with a microscope, after proper preparation, we can see the structure of the wood from which the coal was derived. Of eighty-one distinct seams of coal in Nova Scotia, every one but two or three had Sigillaria, either in the coal or immediately above or beneath it. The top of a coal seam is merely the debris of the last forest that grew on the swamp where the coal was produced. Great Britain annually consumes 100,000,000 tons of coal, and we know of nothing that will supply its place. The consumption of coal in America is already equal to the labor of 150,000,000 horses, and our coal beds are as yet hardly opened. All this power is extracted from the sunbeams of the Paleozoic period. What did these magnificent forests grow for? There seems to have been no higher animals to enjoy them. We know of no birds that lived among their branches. There were a few insignificant reptiles that crawled beneath them, but we know of nothing higher in that age. What were they created for? For two great purposes. First, to purify the atmosphere, so that it might be made suitable for the higher animals that were to live in a future geologic period; and that very process of purifying the atmosphere was made the means of laying up those enormous stores of fossil fuel upon which so much of our modern civilization is based. See how grand are the economies of nature, preparing far back in geologic periods before man existed, for the existence of the present state of the arts in the world. Next to coal, in its value, comes iron; and although we are not so dependent upon the coal formation for iron as we are for coal, still we get an immense quantity of iron from the carboniferous rocks, accumulated by the agency of these very plants; for as they went to decay, and were converted into coal, they helped to gather together the particles of iron out of the clays and sands, and to store them up for us in beds of iron ore. Therefore we owe to the growth of those old forests not only our coal but a large portion of our iron. And whether we look to the value of the coal in boiling the tea-kettle, of which Prof. Silliman spoke to you in the last lecture, or to the coal and iron which make and feed our iron horse, and the steam engine of our factories, we owe it all to the primeval plants, or rather the Maker and Creator of these old plants.

Let me trace these plants a little further back than the period of the coal formation. If we go back from the carboniferous rocks to the Devonian, we shall find a different flora, which no doubt helped

to purify the air, and prepare the world for the carboniferous flora. We have in Canada a bed of coal two or three inches thick, belonging to that epoch, and it is the only one I know of in America. In this drawing, some of the plants of that period are represented; and here you find the Sigillaria, the Lapidodendron, the Calamites, the pines, &c., as in the latter period; so that you see that the Devonian flora was really not very different from that of the carboniferous period. The species are mostly different, but the generic forms are the same. As a whole the Devonian flora may be characterized as less massive and magnificent, more delicate and slender in its proportions; not less beautiful, but less useful, perhaps, in the accumulation for us of vast stores of fuel. If we go down below the Devonian rocks into the Silurian, we find a few plants; but in the lower Silurian formation we hardly find any traces of plants. Nearly all the rocks known to us of that age were marine rocks. Prof. D. was not hopeless of the Eozoic period even. We have as yet found no plants there; but we have found carbon. We have found plumbago; and even in later formations the remains of plants have sometimes been converted into black lead. We have immense quantities of graphite or black-lead in the Eozoic strata, occurring in beds, so as much to resemble the remains of plants. They may have been sea plants. If they were land plants we may guess what they were—Anophytes and Thallophytes, gigantic mosses and gigantic lichens. If we were to walk among those ancient forests of mosses, if they really did exist, we should be in a world something like what this would appear to an insect creeping upon the mosses of our woods. I have given you but a faint outline of a great subject, on which treaties might be and have been written, which would afford the material for a course of lectures more interesting than a single one can possibly be. The chief interest of the subject, no doubt, is to the botanist and geologist. The vegetable kingdom now is most beautiful and most varied, especially when we look at it as presenting forms of plants adapted to every climate and every situation upon the earth, all of them finding their proper place and their own due season. But the subject before us carries us back into geologic times, and shows us a plan too large to be realized on one earth. The plan of the Creator was so vast that the whole surface of the earth was not big enough to hold it. It required a series of earths, one after the other, to develop it, just as it has required a series of ages to develop the history of the human race, We have in these old plants something that adds enormously to the variety of the

vegetable kingdom; something that shows us how small is our own knowledge, and how great and capable of extension is the plan of the vegetable kingdom. And when we consider further that we know of these fossil plants only what their remnants have taught us, it affords a widening field of wonder and of thought. As it is more interesting to the botanist to go out and collect plants for himself than to study them in the class-books, so this subject is of the deepest interest to those who will examine the primeval flora and the coal formations; who will split open the rocks and see the forms that no one ever saw before, and perhaps make discoveries of facts which the world never knew before concerning that remote period of time. I must plead guilty as a fossil botanist—I mean a botanist studying fossils—to having the deepest interest in this subject. And it arises in part from the very fact that different names are sometimes given to the same plant—as the tree is called sigillaria, the root stigimaria, and the nut still another name; and it requires much observation and study to discover and to show that these different names all belong to what was really one and the same plant. As our knowledge increases we may be able to dispense with many of these old names, which is more than can be said for modern botany. What would we have been without these old plants, without this great provision made for us in primitive times, before man existed upon the earth? These plants form a part of the same plan to which we belong, and undoubtedly that plan existed at the time these old Paleozoic plants grew. And now, I may say, even in this Christmas time, as we gather around the hearth, although our coal fire does not roar and cackle and blaze like the old yule log of our ancestors, yet the trunks of our old Sigillaria, burning upon our hearths to-night, send forth a quiet, kindly glow, befiting their great age and long burial in the earth. And the happy hearts that gather around the Christmas fireside may thank God that we have had these great stores prepared for us in the times of old, and that we have hearts and minds fitted to enter somewhat into that great plan which stored them up, and for the enjoyment, in a measure, even of the beauty of the plants that lived so long ago.

SCIENTIFIC LECTURE.—VI.

ON THE GEOLOGICAL HISTORY OF THE NORTH AMERICAN CONTINENT.

By Professor James Hall.

Prof. James Hall, State Geologist, on Wednesday evening, December 30th, delivered the sixth of the course of Scientific Lectures before the American Institute at Steinway Hall.

His subject was "The Geological History of the North American Continent."

Judge Daly, in introducing the lecturer, said that the last lecture was one of the most interesting of the course, and to-night the audience would have the pleasure of listening upon a kindred subject to a gentleman whose reputation as a geologist was not limited to our own State or to the United States. His reputation will be perpetuated by a noble monument of more than twenty volumes upon the Natural History of the State of New York, several of which have been produced under his scientific supervision. It is generally admitted among scientists, that the great work on The Natural History of New York, which has been published by authority of the State, has never been equalled by any similar undertaking in any part of the old world. Prof. Hall said:

Ladies and Gentlemen: I am unprepared to say a word in response to the complimentary notice of your President; but one word I will say as an adopted citizen of New York, speaking to citizens of the State of New York, that the natural history of the State is a monument of which in after generations every man, woman and child will have reason to be proud. It has been carried on for many years, and amid many difficulties. For the humble part I have had in this work, I have had many pleasures, many griefs, and many sore trials. But all these will be past, and those who come after us will reap the benefit of a work that has developed much of natural science, and which was in fact one of the earliest results of the study

of natural science upon the American continent. The subject upon which I design to speak to you is the geological history of the North American Continent.

Geologists do not consider the American continent as the product of sudden action. Geology, in fact, in its progress, has shown us, step by step, that long periods in the past have existed while the changes on the surface of the globe have been going on very much as they are now going on; periods of time so vast and so extended in the past that the geologist who has studied most earnestly for a lifetime comprehends more fully than any one else the sublimity of that passage, "In the beginning God created the heavens and the earth;" for that "beginning" has to us the significance of being incomprehensible in the past as eternity in the future. Before speaking, however, of the subject at hand, I beg leave to call your attention to some of the processes going on upon the surface of the earth at the present time. This will make more intelligible to you what I shall say in regard to the manner of the distribution of materials over the ocean bed.

Upon every portion of the surface of the earth we have mountain chains, plains, and valleys; and we have rocks, loose materials, sand, pebbles, gravel, and other substances of that kind, which are distributed over the surface. These are distributed, not uniformly, but according to certain laws, which have prevailed in all geologic time. This pebble, for example, which I have before me, has at one time been an angular fragment of stone, broken from a rock which had itself been, at a still earlier time, a loose mass of sand, which has been consolidated. It has become rock. It has again been broken, and these pebbles have been triturated by the action of the water, the action of the sea, or of rivers and streams, until the angles have been worn off, and the surface rounded; the finer materials being gradually worn away and disappearing in the deeper water, reduced by its action to an impalpable condition. The harder particles of material like this make the sand which strews the sea beaches everywhere. The sand was not derived from the breaking down of sandstone, but from the breaking down of materials containing sand or silex. While the finer and less palpable, and the more soluble portions have been widely separated, the harder portions, which are a silicious sand, remain to make sea beaches and river beaches. In this respect nature is constantly active. There has been no moment of time when this process, this degradation of the surface of the globe was not going

on. During every shower, or if you will go back to the first cause of all this, the evaporation of water by the action of the sun's rays upon the ocean and upon the surface of the earth, lifting it into the atmosphere and precipitating it again upon the surface, transfers the loose materials into the smaller streams, thence into rivers, and thence into the ocean, where they are spread out evenly from the facility of their transportation by currents, the coarser materials being first deposited, and then the finer. And the action of the frost annually prepares these materials for the subsequent action of the rain. The water percolating into the crevices of the rocks freezes, and by its expansion in freezing separates them, until year by year, more and more of the rocky mass is broken down and the material prepared to be transported by the rain-storms to the ocean. Regarding this as an outline of the hills and valleys that you may find almost everywhere (drawing upon the blackboard); penetrating beneath the surface you find sand, gravel, and pebbles. But if you penetrate a little further, excepting in comparatively rare instances, you will find beneath the accumulations of gravel, rocks lying in a nearly horizontal position; beds of limestone, slate, and sandstone. These layers of rocks have once been continuous, they have extended across the valleys. Those portions of the strata, once filling the spaces between the hills, have, by the action of water, been worn out. This essentially horizontal position of the strata prevails in nine-tenths of the area of the west. I will now give you an example of another position of the strata. On the one side of the valley you may see the strata inclining beneath the surface and on the other dipping in the opposite direction. But still these strata have once continued across the place of the present valleys; and the same is essentially true in all localities where the rocks are inclined, though they may dip very steeply, as in your own neighborhood. These are nevertheless valleys of erosion. The materials which once filled the valley, and made these strata continuous, have been eroded and worn out by the action of water and of ice. The fact is that the dip of the strata does not change the law, for the beds have had this curved form (supplying the connection), but the valley has been broken through wherever the strata are wanting. It is a demonstrated law that whenever rocky strata are bent upward they are weakened, so that the summit of the arch is the weakest point. All the materials which are spread out beneath the surface of the ocean, and all the rocky strata, as they are originally deposited, are horizontal or very nearly so. This arching

of the strata is the result of a subsequent operation; and wherever it takes place it weakens the beds, so that they are more frequently eroded along the line of folding than elsewhere. It is to be kept in view that the materials out of which the rocks of the continent are composed have been distributed over the bed of an ocean. They consist of materials transported from pre-existing continents or islands, which are carried into the ocean and spread out over its bed.

Before speaking of the history of the continent, I will point out the divisions by this chart. This color represents the earliest known portion of the continent, composed of sedimentary deposits. We know of no other rocks except those which have been deposited from water, except in very limited areas. All the materials which compose in any great degree the North American continent have been deposited from water in the form of sand, clay, and limestone; the limestone being originally in the condition of fine mud or a calcareous sand. We have in these rocks the evidence of this condition in the shape of corals, which can only exist in a quiet ocean. We have here shells similar to those in our modern oceans, and of a character showing that they have lived, not in the deep sea, but along the shore line.

It has only been within a comparatively few years that we have come to a knowledge of the fact that the northern portion of the American continent is formed of stratified sedimentary rocks. All this granite region of the country, stretching along the St. Lawrence, occupying a great portion of Canada, reaching towards Hudson's Bay, and extending southward into the northern part of New York, is composed of nothing more nor less than sedimentary rocks, deposited as sand or carbonate of lime, having subsequently undergone the change we call metamorphism. This older granitic portion of the country—granitic because its materials are of coarse, crystalline matter, of which I have specimens here before you, is essentially embraced within this northern portion of the continent colored red upon the map. This formation, known as the Laurentian System, has an enormous thickness, composed of beds of gneiss, crystalline limestones, Labradorite, or felspathic granite, together with gneissoid or sienitic conglomerates in some parts of its extent, which, as a whole, has resulted from the sediments deposited in this primeval ocean through countless ages. All this had been accomplished before there was any spot of land to which we can point as constituting part of the American continent, and where all that area which I now present to you upon

this map, in its different colors as indicating geological formations of certain ages, was one vast expanse of ocean.

At a later period this ancient ocean bed was raised above the sea level, constituting the earliest known form and condition of the North American Continent. The limits of this Laurentian area marked the earliest coast line with which we are acquainted. Along this shore line, and throughout a considerable portion of its extent, were accumulated large areas of sand and pebbles forming conglomerates, and fine sand giving rocks of quartzite. Still the outline of the early continent was essentially maintained by the rocks of the Laurentian system.

Above all these, and constituting the beginning of the next great geological period, there came, along the entire coast line, an extensive deposit of coarse sand and pebbles ending in fine sand. This formation occurs on the northeast in Newfoundland, and extends southward throughout the central portion of the country, and westward even to the Rocky mountains. This was the earliest sand beach known, skirting the ancient American continent, which then had no further extension southward than you see upon this map; limited on the south by the latitude of the great lakes, except small detached portions which may have been islands in the ancient sea. This entire belt, skirting the old continent as a sand beach, was converted at last into sandstone, known in our modern geological nomenclature as the Potsdam sandstone. Let me say here that this northern portion of the continent has never, so far as we have evidence, been entirely beneath the water since this sand began to be deposited. Some portions have been eroded, because this area is marked by hills and valleys the same as other parts of the continent, and some of the lower valleys have been invaded by the ocean, to a small extent, but never the continent as a whole. Above this sandstone we have a series of limestones, and other rocks; but in order that you may better understand the details, I will refer to this other map which shows more distinctly the order of succession, as it has been developed in the course of the last twenty-five years in the geological surveys which have been made; first in the State of New York, and subsequently in other parts of the United States, and in Canada, where the researches have developed the same system of rocks we have found here. [Reference to geological map and sections.]

To illustrate the fact that these formations have all been deposited beneath water, I have here a specimen, covered with the shells of

animals which have lived upon the sea bottom. We are not only able to trace these formations by their contained characteristic fossils, but we know which have been formed nearest the shore; for there are certain animals living near the shore-line, and others which live only in the deeper sea. Tracing these deposits, as we go westward the materials become finer and finer until at last they die out almost entirely. But along the line where we now have the Apalachian chain of mountains, stretching from the north-east down to the extreme southern limit of the country, we find coarse materials accumulated in large quantities. The same formations of which these mountains are composed extend westward, but the sediments are there finely comminuted mud; so that the geological formation which in the east is sandstone often becomes a soft calcareous mud in the west. This is in consequence of the law I mentioned just now, that near the coast we have sand and coarse materials, but no clay or mud except in quiet places. Wherever the sea has full force of action we have sandstone, or coarse deposits; but toward the center of the ocean, finer muds are carried. We have then, in the neighborhood of the original land from which the sediments were derived, the coarser materials, and finer materials as we proceed westward and south-westward. We have here, along this belt of greatest accumulation, the successive formations one above the other, until they reach a thickness of 20,000, 30,000, or even 40,000 feet. After the deposition of this older sandstone, we have a long period where the limestone prevailed, when calcareous deposits covered the bottom of the quiet ocean, and corals and shells in great numbers lived in the sea. This condition, however, prevailed more completely in the central portion of this ocean area, while there was little accumulation of that kind in the eastern part. In this area, which now constitutes the eastern middle portion of the continent, we find in New England, New Brunswick and Nova Scotia, comparatively little limestone, while it is the prevailing rock over large areas in the west. This line from the north-east to the south-west has been, from the beginning of this geologic period, the line of littoral currents and the accumulation of the coarser sediments.

There may have been some source of these materials which we do not know; but we know from the laws which govern the breaking down of rocks, and distribution of sediments, that most of them have been derived from a direction to the eastward of this portion of the continent. [New York and New England.] We say most emphati-

cally that the material was derived from the east and north-east, because the coarser part is deposited along this line, and the finer is carried towards the center of the continent; for it is evident that the finer sediments would be transported by the gentler currents, while the coarser ones would not. Throughout the West, between the Apalachian chain and the Mississippi river, you have a great plateau, covered almost altogether with fine sediments or calcareous mud. It is not because this is of a different age from the mountain range; it is not because of any change that it has undergone, but it is simply that along the line of the Apalachians the coarse sediments were deposited by the ancient currents, thus forming the outline of the continent. This outline is due to no other cause whatever than the deposition of these coarser materials along the course of the ancient oceanic currents; while the finer were swept, by gentler movements, farther towards the center of the great ocean.

Before we proceed further, let me refer to this chart which represents the different strata as we should find them passing southward from the region of the Adirondack mountains. You will find the different formations represented here, one above another, this being a section, cutting down through the entire series—the Silurian lower and upper, the Devonian, and the Carboniferous. Those of which I have been speaking especially are the Silurian; but we have, nevertheless, complicated with them in the mountain regions, rocks of Devonian and Carboniferous age. As soon as we pass to the westward from the disturbed region, these rocks become highly fossiliferous; and I have in my hands a mass of stone, of Devonian age, taken from the eastern part of New York, which is crowded with shells as closely as you can find them now imbedded in the mud upon the sea coast. Though we have strata of a thickness of thousands of feet characterized by similar shells, and marine plants of littoral growth, yet we know this was deposited in proximity to the shore, or in shallow water, from the character of those fossils, which belong to the class of animals living near the shore. Such accumulations of sediment, of many hundreds of feet in thickness, everywhere giving evidence of shallow water, could only have been made upon a sea bottom which was being gradually depressed.

As you pass away from this shore line, these forms gradually diminish in numbers until you have none of the same shells whatever; but you get at last, in the calcareous mud throughout the great plateau of the

Mississippi, an entirely different set of fossils. Nevertheless we can trace these rocks through the entire length of the Apalachian chain, succeeded by what we know as the Carboniferous formation the characters of which have already been discussed before you in the last lecture. In the early part of the Devonian period—the Hamilton group of New York—we begin to find land plants. Throughout the series of rocks, many thousands of feet in thickness, from the beginning of the Silurian period up to this point, we have seen no vestiges of land plants.* The entire area had been covered by an ocean, and not only this, but there had been no drifted materials indicating the existence of dry land in the region from which the sediments had been derived. There have in earlier times been evidences of a shore line, or of current lines in proximity to the shore, but no evidence of dry land whatever.

These dry land plants of the Devonian period, however, are mingled with remains of shells and other organic bodies of marine origin, or they occupy layers of the rock, above and below which the beds are filled with marine organisms; and from this we infer that these plants have been drifted from their original position.

The formations of the Devonian period are succeeded by what is termed the Carboniferous period, in consequence of the strata then deposited, being, in Europe and the eastern part of the American continent, the great repository of coal. You have already been told that coal is produced from land vegetation; and when we see the coal fields extending from Nova Scotia and New Brunswick over a great part of the United States, you will be prepared to look for evidences of dry land also. In the Hamilton and Chemung groups of the Devonian system in New York, the land plants do not indicate very close proximity of land, or at least till the later deposits of that period; while in the coal period we have evidence of its extension over large areas previously covered by the ocean. From the earliest appearance of land plants, there seems to have been a continued accession of dry land until it had extended westward at least as far as the longitude of the Mississippi Valley. However, this encroachment of dry land upon the area of the ancient ocean was by no means constant; for we find that both preceding and during the period of the accumulation of the sands and clays which form the Coal measure strata, there are beds of limestone of greater or less

* From the earlier appearance of land plants in the north-east, we infer that dry land first appeared in that direction, and some of the fossil plants of that region may be of Silurian age.

extent and thickness, and these indicate a depression of the ocean bed and a quiet sea. In the Coal measures, we are able to demonstrate in the most satisfactory manner the gradual encroachment of the coast line upon the area of the ancient ocean. We find layers of clay and sand pushing out to the westward, overlying the limestones which have been deposited in a quiet sea. These beds of sand, clay, or coarser materials, are charged with the remains of plants which must have grown upon or near the place where we find them imbedded, and in some instances, the roots remaining in the soil upon which they grew and flourished. Such conditions can have come only from the gradual elevation of the ocean bed, allowing that part so lately covered with its waters to become extensive marshes and moderately elevated areas of dry land, which supported this growth of vegetation.

During the latter part of this period the dry land has extended as far westward as Missouri and Kansas, as we have evidence in the extension of the Coal measures. It is in this region that the Coal measures, or coal-bearing portions of the great Carboniferous system of rocks thin out, and lose the character which has given them their designation; and this system of rocks gives us one of the best examples of the thinning out of sedimentary strata which we have in the whole series. On the northeast coast in Nova Scotia, the coal formation has a measured thickness of from fourteen to sixteen thousand feet, while the same formation on the west of the Mississippi has a thickness of a few hundred feet only. But it must not be understood that the formation disappears here, for it is only the land and shallow sea accumulations that thin out. The ocean deposits were still going on, and the limestones of the same age extend westward and southwestward to the Rocky mountains and New Mexico.

We learn from these facts that geological formations of the same age may, at their extremes, be composed of very different materials, and so unlike as to have few or no points of similarity. To us in the east, this period indicates the formation and accumulation of the coal beds, and is really the *Carboniferous period;* while in the far west and southwest, the term is entirely inappropriate. There it is represented by rocks of limestone, and soft shales or marls, filled with fossils of marine origin and destitute of coal. We have in the study of this series of strata the most positive evidence of the gradual rising of the land on the east, and the gradual evolution of this part of the continent from the bed of the ocean.

We are not to infer, however, that because we have seen these evidences of the oscillation of the ocean bed so conspicuously marked during the Coal period, that similar conditions did not exist in preceding geological periods. In this period we have the changes more strongly marked by the presence of land plants in strata which alternate with beds containing marine fossils; while in preceding geological periods, the change is mainly marked by the alternations of limestone beds of the quiet ocean with strata of sedimentary origin, both containing marine organisms. In each one, however, the conditions are indicative of oscillation or changes of level in the ocean bed; evidences of that earlier movement, which has finally given us the North American continent in its second phase. Glancing over the map which is before us, you will see that all this portion of the continent is occupied by rocks of those geological ages of which I have been speaking. It is true, that along the coast, and in a few of the valleys, you have geological formations of later date, which have been elevated above the ocean level by subsequent movements of the continent, but they form no essential part of the continental features of that period.

It is not a little interesting to observe that the source and distribution of the materials of all these sedimentary deposits is essentially the same; each successive period spreading its coarser sediments in the same direction, or with a gradually more western trend in the later deposits, and finally, and as a consequence of this, the earliest dry land appearing in the direction of this source of the sediments.

Having passed in review these successive formations, we naturally still inquire how they have become dry land, and not only dry land, but a considerable portion of this area of mountain elevation.

It is the common belief that mountain chains are due to some violent action, as the breaking and uplifting of the crust along certain lines; and this has been accepted as an explanation of the elevation of mountains and adjacent tracts of country. Now, however, since we have more carefully studied the structure of mountain chains, and the nature of their materials, we find them composed of the same kinds of sediment as the rocky strata of other parts of the country. We find, in short, that they are composed of stratified rocks; and however much they have become changed in position or in their condition, they are the results of sediments deposited in the ocean. Although in certain parts they are highly crystalline, we yet sometimes detect organic remains, and the lines of regular bedding still

remain. When we trace the same beds beyond the influences which have folded, contorted and crystallized them, we find that we have a part of the same series of rocks which we know elsewhere as bearing evidences of having been deposited in the ocean in the form of sediments. Sand, clay and carbonate of lime cannot be deposited in regular layers in any way except by the action of water; and there is no other means of having them filled with these organic remains, than by their gradual deposition in the ocean. More than this, we have evidence of shallow water in the ripple marks, showing that the bed of the ocean was sometimes near the surface, and at other times was left dry by the receding tide and recovered by its flow; for it is well established that the tide ebbed and flowed during that time as it does at the present.

The results of the careful study of the geological structure of mountains and the chemical nature of the rocks composing them, as well as the palæontological evidence when it can be had, all go to sustain the views I have advanced.

The rocks of the mountains are therefore a part of those of the plain, and should not be looked upon as having a different origin. We have, also, the most positive and unequivocal evidence of the manner and conditions under which the materials of these rocks have been deposited upon the bottom of the ancient ocean, and we are able to trace the successive stages of progress and development, until finally, during the Coal period, we see this ocean bed becoming dry land. Now, there is no evidence of any special disturbance during the Coal period, or at its close, which would have raised the ocean bed above the surface of the water. Moreover, this was no local or limited influence; for you will see, by reference to the map, that it pervaded the entire country from the extreme northeast, from the Gulf of St. Lawrence, and along this valley by the great lakes, far to the westward beyond the Mississippi river, and southward to Georgia and Alabama. Such a result, co-extensive in its operation with this portion of the continent, cannot be due to influences like those producing earthquakes or volcanoes. The change from sea bottom to dry land has been a gradual one; the causes were inaugurated at the commencement of the deposition of the Palæozoic strata upon the flanks of the old Laurentian continent, and they have continued in operation throughout the entire time occupied in the accumulation of these rocks, increasing in force, until at the close the greater part had become a continental area. The change was a slow one, depend-

ent upon the accumulation of sediments, and the causes are not to be sought for in any special elevatory movement.

Now in order to arrive at any rational explanation of this phenomenon, and the causes producing it, we may refer to what is understood as a well established law, dependent on the conditions of the interior of our planet. It is well known that the crust of the earth, the continents and the islands, are not stationary: first, as I have already stated, they are subject to abrasion and degradation from the influence of the elements; and second, it is known, by comparison with the ocean level, that certain parts of continents along the coast line are rising above, or becoming depressed below, the sea level. Such a movement can only arise from the interior portions yielding to the pressure from above; and whether this yielding may be due to partial or entire fluidity of the mass, from heat, it is not necessary now to inquire. That oscillations of the surface have taken place in modern times as well as in former geological periods, is well proven. Admitting this condition of the interior, the transfer of material from one part of the earth's crust to another will cause a disturbance of the equilibrium of pressure, and a consequent change in the elevation of some other part. At the same time, the transfer of material from one part to another will likewise disturb the equilibrium of temperature; and we have both these forces operating at every change of condition or transfer of materials upon the earth's crust. Now, whenever materials are transported from the shore and spread over the bed of an ocean as in the case of our geological formations, the first tendency is to disturb the equilibrium of pressure, and the area of accumulation would be gradually depressed; but as these deposits accumulated and the depression went on, they would at last be permeated by the increasing temperature and finally brought to that degree when expansion would take place, and the entire mass be finally elevated. Or, to make myself better understood, we will assume that at the depth of 1,000 feet there is a certain temperature, due to internal heat. If then, by depressing the surface, or by any other means, we are able to pile upon this 5,000 feet of new material, the internal heat will gradually penetrate the mass until the equilibrium of temperature is attained, and we shall have essentially the same degree of heat at 1,000 feet below the new surface that we had at the original point now 6,000 feet below. At the same time, this deeper point will have acquired a higher temperature in proportion to its depth beneath the surface. This accession of temperature will necessarily

expand the mass, and produce an upward movement of the whole. The equilibrium of temperature and of pressure will be gradually restored, and the elevation of the' area will in some degree correspond with the thickness of the original accumulation; but all parts of any zone, over which sediments have been deposited in a certain period, will be affected by the movement. This slow elevating process will not bring back the relative level of the old sea bottom with that of the present ocean, simply in consequence of the unequal distribution of the newly added sediments; and although the height of the mountains will depend upon the thickness of the strata, you can never have them of a height above the sea equal to the entire thickness of the beds of which they are composed.

I have just now shown you that this great area from the Atlantic to the Mississippi river, and from Nova Scotia to Georgia, consists of a series of strata of the same age, but that the nature of the sediments, and the degree of accumulation is unequal in different parts of the area. While we have along the eastern zone, some 30,000 or 40,000 feet of thickness, there is only about a tenth part as much in the west. The elevation of the plateau of the Mississippi Valley region above tide water, may be something more than one-fourth of the entire thickness of the underlying palæozoic strata, while the elevation of the highest mountains of the Apalachian chain is not quite one-fourth the thickness of the strata of the same age along that zone. Now, you will readily conclude from this fact, that there remains no reason for calling in the aid of extraordinary forces for the production of these mountains. The plateau of the west is proportionally as much elevated as are the highest points of the eastern range. It requires only to be convinced that you are dealing with the same set of rocks throughout this extent of country, and you cannot avoid the conclusions which I have presented. The gentler elevations or the abrupt terraces and deep ravines in the comparatively level western country are quite as great in proportion to the thickness of the strata as are the mountain elevations, steep escarpments, and deep gorges of our eastern mountain region. All the changes which have taken place from the first removal and transportation of the sediments to the production of the present continent, in all the features which it carries upon its surface, are due to the operation of the few simple laws which I have enunciated.

I have dwelt longer upon this part of our continent than it

deserves, perhaps, in comparison with the whole; but we know so well the strata of which it is composed, and these have been studied more thoroughly, in all their phases, than any other part of the continent. It is the more easy, therefore, to draw our comparisons and illustrations from this than from any other of the great areas of which the entire continent is composed. And, moreover, the illustrations offered in this continental period are, as I conceive, applicable to all other parts of the continent, and to other continents; the conditions in all having been similar, and the laws operating are everywhere the same.

In this discussion, however, we may consider, for a few moments, the condition of the strata composing the mountain ranges. The beds or strata are tilted, folded or contorted by some action taking place subsequent to their deposition, and after they had become partially or entirely solidified. They are likewise more or less crystalline in texture. This crystalline texture, we say, is due to metamorphism, a change produced upon sedimentary strata by a moderate degree of heat; and we conceive that the necessary augmentation of temperature may have been acquired in the depression of these beds to the depth of five or six miles below the sea level, which depth must have been reached by the lower beds even during the accumulation of the higher strata. However, we know that this change is not due entirely to the influence of extraneous heat, but to the nature and composition of the beds themselves; for we sometimes find the lower beds entirely unchanged, while succeeding beds, several hundred feet higher in the series, are highly metamorphosed. Without discussing this point further, we may remark that metamorphic sedimentary strata usually occur only where the accumulations are very considerable, and that condition is most complete where the strata have the greatest thickness.

In considering the geological structure of this part of the country, I present before you a section of the strata composing the Apalachian chain as shown by Prof. Rogers in his Geological Survey of Pennsylvania. This section, and others of similar character made by myself across eastern New York, and parts of Massachusetts and Vermont, exhibit the strata precisely as they exist, and not as represented by any theoretical views whatever. Such sections not only show the present position and relations of the rocky strata, but they demonstrate most conclusively that there is no line of outbreak from internal forces, nor the intrusion of any rock whatever to produce

the uplifting, as it is usually termed, of this belt of country. The rocks are shown in abrupt foldings along the eastern and central parts, while they recede to the westward in gentle undulations. It is evident that no force applied directly beneath these strata could have produced such a result as we see, and it becomes a question of the highest interest to determine the cause which has given us this structure. We cannot fail to observe, moreover, that the strata dip away from the valleys and beneath the mountains almost invariably, and that the mountains are composed of beds, not arching over their tops, but dipping from each side towards the center of the mass Every one of these ridges, whatever its extent, is composed of regular beds succeeding each other, and the whole may be examined from the bottom to the top.

I shall offer an explanation of the cause, which I suppose may have produced this folding and plication of the strata; and this cause is connected with the conditions of deposition of the original sediments. The belt of country affected in this manner extends from Nova Scotia to Georgia, and has a width of one or two hundred miles. We have seen that the sea was at all times shallow, or of moderate depth. The accumulations, therefore, could only have been made by a gradual or periodical subsidence of the ocean bed; and, we may then inquire, what would be the result of such subsidence upon the accumulated stratified sediments spread over the sea bottom?

The line of greatest depression would be along the line of greatest accumulation, and the depression would be less in the direction of the thinning margins of the deposit. By this process of subsidence, as the lower surface becomes gradually curved, there must follow, as a consequence of this movement, either rents and fractures upon that side, or the diminished width of the surface above, caused by this curving below, will produce wrinkles and foldings of the strata. That fractures may occur on the lower side, to some small extent, is probable; but the folding of the strata would seem to be the natural and inevitable consequence of the process of subsidence.

The depression of the mass produces a great synclinal axis; and within the inclined sides of this greater synclinal, whether on a large or a small scale, will be produced numerous smaller syncinal and anticlinal axes. This fact is true of every synclinal axis, where the condition of the beds is such as to admit of a careful examination. I hold, therefore, that it is impossible to have any great subsidence along a certain line of the earth's crust, from the accumulation of sediments,

without producing the phenomena which are observed in the Apalachian and other mountain ranges.

You can have some conception of this process of folding of the inner beds, by taking a pile of sheets of paper, so confining the edges that they cannot slide one over the other, and then depressing the centre; as the lower sheets assume the curving direction, the upper ones will curve upwards, or wrinkle, in consequence of the contraction of the space between the edges. An elementary illustration of this kind was formerly used to show the effects of lateral pressure in the folding of strata. Now, a set of strata of mud and sand, one or two hundred miles in width, cannot slide over each other, as sheets of paper do if left to themselves, during the process of depression.

I have shown, by the slow accumulation of the sediments and the evidences of shallow water, that the subsidence was gradual; we have, moreover, proof that it was periodical; for we find the lower Helderberg group resting unconformably upon the upturned beds of the Hudson River group, showing that previous to the deposition of these limestones, there were foldings and plications of the lower strata, along the line of accumulation. Subsequently to the deposition of the later formation, there have been other periods of subsidence, and consequently of folding and plication. These movements, therefore, are not synchronous, nor are they conformable with each other; and hence arises much of the difficulty of tracing the geological structure in disturbed and mountainous regions of country.

Now, according to the view I have taken, the zone of greatest accumulation should be that of the greatest depression and ultimately of greatest elevation, and consequently the foldings of the strata would be more extreme along that line. This condition we find to be true; and as we approach the margin of this zone of depression, and as the beds become gradually thinner, the foldings become less extreme, and die out in gentle undulations on the west.

It might, perhaps, be suggested that these foldings, coming from the depression and necessary contraction of the interior of a great trough or synclinal, would be removed on their subsequent elevation, and the beds might assume in some degree, at least, their original position; but I have already explained that this is not the mode of elevation. The movement has been a gradual one; for the restoration of the equilibrium of pressure and temperature and the elevation has been continental, and not local.

Before leaving this part of the subject, I will endeavor to give

some explanation of the origin of the hills and valleys of this mountain region.

Had this disturbed zone been elevated above the ocean level, without change or fracture, we should have had a grand series of parallel, or nearly parallel, arching ridges formed by the anticlinal axes. But this folding of the beds has necessarily weakened them along the summits of the arches; and in the slow process of their emergence from beneath the ocean, these lines have been the first to come within the action of the waves: the erosion of the valleys, then begun, was continued by the abrasion of the broken edges, till we have the broad depressions marking the place of nearly all the anticlinal axes. In some instances, where the beds are strong and heavy, the arch has been preserved; and in others, one half of the arch has been worn away, leaving the other half. As a consequence of these extensive erosions of the anticlinals, the synclinal axes remain as the most prominent parts of the range; and it is only necessary to refer to the geological sections before mentioned, to prove this remark.

It nowhere appears that this folding or plication has contributed to the altitude of the mountains; on the other hand, as I think it can be shown, the more extreme this plication, the more it will conduce to the general degradation of the mass, whenever subjected to denuding agencies. The number and abruptness of the foldings will depend upon the width of the zone depressed, and the depth of the depression, which is itself dependent on the amount of accumulation. We have, therefore, this element of depression to consider, when we compare mountain elevations with the thickness of the original deposition. In all cases where the strata are more or less disturbed, a large proportion of the sediment constituting the mountain range will remain below the sea-level, as a necessary consequence of the great accumulation.

If the facts presented warrant the conclusions I have drawn from them, I think we are able to deduce some general principles in regard to the production of mountain ranges. To explain the existence of any such range, we are to look to the original accumulation of matter along a certain line or zone, the direction of which will be the direction of the elevation. The line of the existing mountain chain will be the course of the original transporting current. The minor axes or foldings must be essentially parallel to the great synclinal axis and the line of accumulation. The present mountain barriers are but the visible evidences of the sedimentary deposits upon an

ancient ocean bed; while the determining causes of their elevation existed long anterior to the production of the mountains themselves. At no point, nor along any line between the Apalachian and Rocky mountains, could the same forces have produced a mountain chain, because the materials of accumulation were insufficient; and though, we may trace what appears to be the gradually subsiding influence of these forces, it is simply in these instances due to the paucity of material upon which to exhibit its effects.

I have endeavored to trace with some degree of detail, the processes which have been going on through all this palæozoic or ancient life time, as we know these formations in geology by that designation. I have shown you the results of the long continued action of gentle operations, without the intervention of those violent movements of the interior forces, or of catastrophes which are appealed to for the explanation of the existing conditions. In this view, the history of continental formation may lose some of its exciting interest, but it seems to me to lead to more rational opinions concerning the geological structure of this part of our continent, and of the laws which govern the distribution and accumulation of sediments upon the ocean bed, giving us finally the rock formations in which we find the record of life upon our earth from its beginning.

It may be said that these observations are too limited to be made applicable to other continental areas or other mountain chains; but the same features, to a very large extent at least, are presented in the old Laurentian continent and its mountain ranges. It would hence appear safe to conclude that the laws, so clearly operating here, have operated similarly elsewhere, and that the process of continental evolution and of mountain elevation has been the same in other countries as in our own.

Turning to the map before us, you will observe that the eastern shore of our continent is skirted by a different color. You have likewise, in the Connecticut valley, and along New Jersey, Pennsylvania, Maryland, Virginia, North and South Carolina, a belt of different color, separate from the coast-line belt, the whole indicating a series of newer formations than those forming the great eastern continental area. This coast-line belt widens to the southward, and presents a broad area across the southern border of the United States. It extends up the valley of the Mississippi, as far as the mouth of the Ohio, westward, through Arkansas and Missouri, and in a broad belt far up into Minnesota. It occupies the great valley and plateau of

the Missouri, for hundreds of miles in width, and stretches to the west and southwest, becoming the prevailing color of the map in that direction, and showing a great area occupied by geological formations, newer than the coal.

The age of these geological formations as determined by their fossils, proves that the entire area occupied by them has been for a long period beneath the waters of the ocean after this part of the continent on which we live had become dry land. We are not yet so familiar with all the changes that have taken place over this area, that we can indicate, step by step, the process which has at last developed this portion of our continent from the abyss of ocean sediment. The successive formations show the presence of all those which succeed the coal formation in the great geological scale. The New Red sand stone, or Triassic formation, is succeeded by the Jurassic and this by the Cretaceous and Tertiary.

It is certain, that in the Cretaceous period, dry land had made its appearance within this western ocean; for we have abundant evidence of this condition in the presence of land plants, distributed over wide areas, and having a great north and south extension, probably parallel with the line of continental elevation.

During the Tertiary period, it would seem that a great portion of this northern and western area had been elevated above the ocean level, and was occupied by immense lakes of fresh water, which, as the continent rose, gave place to dry land, with a fauna and flora of peculiar character, extending over enormous areas. The vegetation of this period, it is true, was not very dissimilar to that of the present in many respects, but it carried many genera of the more temperate latitudes of the present day, far to the northward towards Hudson's Bay, and into Greenland.

You will perceive, therefore, that this portion of our continent, stretching upon both sides of the great Rocky mountain elevation, and occupying a large extent of the adjacent region, is of very recent origin. The crests of the Rocky mountains, which are of old granitic rocks, may have been islands in this ancient sea, yielding by abrasion, materials to build up the modern formations and the newer continental area. This later addition to our continental area is, as you will observe, not only much larger than the preceding one, and including some portions which may have been islands, is much larger than all the pre-existing area.

The principal point which I have endeavored to illustrate, is that

our continent, as a whole, was not formed or called into existence at once, nor was it elevated from beneath the ocean as a single continent in its present form and extent. It has been produced step by step, and by slow accumulation through many long geological periods. The materials of which it is composed have been derived from the breaking down of pre-existing continents and islands, and the transport and deposit of the sediments thus formed, until one portion after another has invaded the oceanic area and become dry land. Each portion thus rising above the ocean level has furnished, through the action of the elements as I have shown you, materials to be distributed over the ocean-bed for the foundation of the next succeeding dry land. and thus by a process of destruction and reconstruction, constantly going on, the equilibrium of the forces is kept up; the existing state of things at any epoch being only a phase preparatory to a subsequent change.

The greater changes which have taken place are obvious to all, but the intermediate steps or progress are not so readily seen. We speak of the geological formations and their succession; but within all these are minor and less conspicuous changes. We see among the formations termed Silurian and Devonian, some twenty or thirty different epochs, each marked by its characteristic fossils of fauna and flora, indicating as many minor changes in the condition of the ocean bed. In the sediments of each of these phases, we have probably as many species of marine animals as are now living along the coast of the United States. When we consider that these various animals have lived and died, that each has occupied its place for successive generations and for an unknown length of time; when we consider that this area has been covered entirely by subsequent deposits, and other creations have taken their place, and so onward, while accumulations hundreds of feet thick have been spread over them; when we remember that hundreds, and even thousands of these generations have lived and died, perhaps in each of those twenty or thirty subdivisions of the period, and thus onward, fauna after fauna, and flora after flora, through all these epochs, you have at last an incomprehensible number of generations of animals, a result which could only have been reached by a process carried on for an indefinitely long period of time. One point which I have endeavored to impress upon you is, that while this has been going on, there has been, so far as our own continent is concerned, a constant evolution of dry land. If we begin at the latest period, and go backward through those preceding it, you have in them all the

distinction of ocean and of dry land, the latest land being formed from the sediment distributed by the ocean, until at last we trace back the continent to the time when it was included within this area (indicating the northern portion).

But during all this time we have seen nothing of what has been termed in geology the original nucleus of the globe; nothing of that crust of matter which is theoretically supposed to have been derived from the slow cooling of a melted mass: nowhere have we discovered any portion of that disrupted primary mass which has been supposed to form the basis and centers of all mountain ranges. All that we know, are stratified rocks; stratified from their deposition as sediments in water. The older Laurentian rocks are not only stratified, but they contain fossils and pebbles of pre-existing stratified rocks. The granites and sienites of the Rocky mountain range are as much stratified, and as truly of sedimentary origin, as are the rocks of northern New York or New England. Not only are all the formations of any considerable extent, of sedimentary origin, but we know that there must have been pre-existing sedimentary strata, pebbles from which were transported and imbedded in those sediments now constituting the oldest known rocks of the continent. You will see, therefore, that we go back not only as far as we can absolutely see the rocks, but still farther, and we demonstrate that there are still earlier periods when there were deposits of sedimentary rocks which are yet to be discovered by geology, of earlier date than the earliest rocks we know, lower than the lowest rocks we yet know; and these being stratified rocks, we may say that water, from the beginning of our knowledge, has existed upon the surface of the globe. We have then no knowledge whatever of the primary nucleus. We see that by the action of water materials have been transported from one part of the surface of the globe to another, covering the former ocean beds with enormous accumulations of sediment; which after a time, by this change in the relation of the parts, and by the increase of temperature beneath the loaded part, have risen up and become, step by step, islands or continents. It is by this process going on, age after age, that the American continent has assumed its present form. But I desire to impress upon you this one truth: that we have not, in our geological investigation, succeeded in going back one step beyond the existence of water and stratification, one step toward the demonstration of this original so called primary nucleus, a nucleus of

molten matter. So far as we have any knowledge of the materials in the interior of the globe, they appear to us only as trap-dykes; and as these occupy but a very small area upon the surface, they may have been derived from a very moderate depth. Beyond this the original nucleus of our planet which has been so much written about in geology, has produced no effect upon the surface of the earth; neither upon its mountain chains, or any other of the great features of the continents. I have shown that in the formation of this continent, the materials composing it have been derived from the breaking down of pre-existing lands transported and deposited along certain lines, or spread out in mid-ocean and there accumulating more uniformly. The inequalities upon the surface of the country are not due to any special action along these lines of elevation. Those mountain ranges, whether the Rocky mountains of the west, the Apalachian chain of the east, or any other range of mountains, so far as we know them, are not due to the action of any special interior forces operating along these lines, but only to the greater accumulations on the bed of the ocean in that direction, as I have shown you more especially in regard to the Apalachian chain. Everywhere the same law has prevailed: the transporting power of the ocean has deposited, in the line of its currents, larger quantities of material which have subsequently been elevated in continental form. The elevation of the eastern part of the North American continent in no way connected the production or elevation of mountain chains farther than they constitute a portion of the continental mass. Going back, then, step by step, from the more recent to the earliest times in relation to which we have any evidence whatever, we have no proof that the violent action of the interior forces of our globe has produced any one of the great features of its surface, beyond the volcanic mountains. This idea of a great primary nucleus is only theoretical. From the earliest geological history, inferring from the trend of stratified deposits, we learn that the ocean currents have had essentially the same direction as at the present time, moving from the northward to the southward, and that the zones of greatest accumulation and of the greatest elevation of our continent have been everywhere coincident from the beginning.

SCIENTIFIC LECTURE—VII.

THE PHILOSOPHY OF THE OVEN.

By Professor E. N. Horsford, of Cambridge, Massachusetts.

DELIVERED WEDNESDAY EVENING, JAN. 6, 1869.

Ladies and Gentlemen: I shall occupy the hour that has been assigned to the lecture of this evening in briefly sketching, in the first place, the history of the oven, and, in the second place, in answering the question, "How may we make good bread?" Our interest in "The Philosophy of the Oven," is very nearly related to our interest in the process of baking, the oldest branch of the art of cooking. The use of heat to increase the savor and digestibility of food, is one of the distinguishing arts of man. Domestic architecture he shares with the foxes and the birds of the air. Engineering is peculiar to him only in degree. The beavers build dams and excavate canals and subterranean galleries. The ants have granaries, and soldiers, and slaves. The bees have a social organization and colonies, and a royal head, and reject the salic law. In every department of inferior animal life we find types of arts which, more or less developed in man, constitute evidences of civilization. But the type of cooking belongs to man. Not among the highest of the anthropoid monkeys, even, has one been found who attempted to increase the palatableness of his food by the use of fire.

Baking or roasting is certainly very old. In the winter of 1853–54, the surface of Lake Zurich, in Switzerland, was greatly depressed. The water in many places retreated to considerable distances from the shore. The owners of the adjacent main land threw up dikes to prevent the return of the water. In the mud thus sheltered, heaps of charcoal and ashes were observed. Intelligence of this discovery reached Dr. Ferdinand Keller, of Zurich, and he hastened to find among the ashes and charcoal, fragments of burned bones and stones blackened by fire. Scattered among these were implements of flint and bone, and ornaments and weapons of bronze. The bones were

of both wild and domestic animals. In some localities, roasted wheat and fragments of bread were found. Around the heaps of ashes were found the charred summits of posts arranged in circular form. These were numerous, and in double rows, like houses along streets. Taking all the facts into account, they were believed to be the remains of what has been called a lacustrine village, which had been destroyed by fire. The charred stumps indicated in each circle the site of a dwelling erected on piles, and accessible only by water, thus securing protection from enemies. In the course of the four or five years following this discovery by Dr. Keller, the remains of not less than 150 similar villages were found along the shores of the lakes of Switzerland. When and by whom were they built? Cæsar makes no mention of them. The race that dwelt there and their habitations had already been swept away. In the neighborhood of Salisbury, in England, within the last two or three years, underground dwellings, entered each through a single hole in the top, have been discovered in great numbers. On the floors were found piles of ashes in which were flint implements and burned bones. Among the latter were found human bones scratched like the other bones with sharp flints, and showing the use they had subserved to the early Britons. The period to which these evidences of the age of the art of baking or roasting refer, no one has fixed. It certainly preceded that of the Roman conquest. Glancing at them from the height of our present civilization, we appreciate the progress that has been made. They enable us to estimate the development of a race, however, rather than of the human family; for it is probable that when the ancient inhabitants of Salisbury Plain were cannibals, Pompeii and Herculanæum were seats of a brilliant, if not a noble civilization, and China was already old.

The Indian Oven.

The earliest device practised by the aboriginal inhabitants of our Atlantic coast, and still in use at our clam bakes, was very simple. It consisted of a shallow hole in the ground, usually paved with small stones. Upon this paved surface a fire was built, and a mass of embers accumulated to heat the stones. When the stones had become sufficiently heated, the embers were removed, the clams heaped in the form of a cone, in their place, and covered with seaweed. The heat of the stones relaxed the muscles of the clams in contact with them, the shells parted, and water flowed out to be instantly converted into

steam, which in its turn, opened all the shells above, and subjected the fleshy parts to a temperature of 212 deg. The lowermost layer of clams was subjected to a heat which produced destructive distillation, giving rise to savory odors which, penetrating the mass above, communicated to the meat a racy flavor of the highest acceptability, as many of us are ready to testify. The oven in use in ancient Syria, of which Sarah on the plains of Mamre took advantage, when directed to quickly knead three measures of meal, and make cakes *on the hearth* for the entertainment of unexpected guests, we may conceive did not differ greatly from our aboriginal device, if we omit the seaweed. But there was also in use a jar-shaped cavity in the earth, cemented on the bottom and sides, in which a fire was built. When the walls were sufficiently heated, the embers were removed, and the dough, prepared by mixing crushed wheat and water, was plastered in thin layers on the sides. This yielded a sort of Graham wafer, a kind of wheaten hoe-cake, of the palatableness of which many of our soldiers during the late war can give testimony, and which was the unleavened bread of the ancients.

The Cottage Oven.

The elevation of this hollow structure to a convenient height above the surface of the ground, may be regarded as the second step in the development of the oven. This usually consisted of an irregular hemispheric cavity, made of clay or stone or brick, supported on a platform, having a door on one side for the introduction of fuel and the dough to be baked, and another lesser opening on the top for the escape of smoke. When the interior walls of this oven had been heated by the flame of dried fine wood, the embers were removed, the dough placed upon the floor of the oven, and the chimney and door closed, leaving the dough to be baked by the radiant heat from the walls. This kind of oven was everywhere to be met with, half a century ago, outside the log-houses of our frontier settlements. As the dwelling-houses were improved, the oven was uniformly given a place in the chimney-stack, beside the kitchen fire. In considerable towns bakeries grew up, and large ovens, on the same general plan as the smaller, were constructed. The objectionable characteristic of this time-honored oven was this: from the moment the dough was introduced the oven began to cool. The oven with continuous heat we owe to Count Rumford. (Benjamin Thompson [Count Rumford, by patent of the King of Bavaria], a native of Woburn, Mass., attained

great distinction as an inventor in the applications of heat. He is best known as the founder of the Rumford professorship in Harvard University, the Rumford medal of the American Academy, and the chief agent in the founding of the Royal Institution of Great Britain.) His oven was an iron cylinder heated from without, and provided with a supply of hot air which might be regulated. It may be regarded as the germ of the cooking-stove and range. He conceived the idea of accomplishing in confined space what, previous to his time, had only been attained before an open fire. He subjected the meat throughout to heat, not high enough to scorch the surface, until the interior of the pieces had experienced the requisite modification to render them acceptable to the taste, and then introduced air heated to a temperature that would promptly brown the surface, causing the destructive distillation which is essential to produce the savor of well roasted meats. The meats so prepared were considered not inferior to the best roast meats produced by slowly revolving them before an open fire, and required very much less fuel.

IMPROVED OVENS.

The brick oven, especially designed for baking bread, has been greatly improved in the direction of economy of fuel and labor. I will call your attention to the plan of the Aerotherme, introduced about a quarter of a century ago in France, which surrounds the oven by trunks of heated air, maintaining, like the Rumford iron oven, a constant and regulated temperature. [The lecturer here explained several diagrams prepared to illustrate the operation of an Aerotherme.] At the Paris Exposition there were several mechanical bakeries in operation. One of them, a French device, had a series of open work shelves, each of the shape of a sextant, attached at the junction of the radii to a vertical shaft, by means of which the shelves could be swung over a bed of coals or into heated space, and kept there till the bread or biscuit was baked, and then carried round to the point of commencement to be discharged. Another, of American invention, had the shelves suspended in a huge, open work cylinder, in which their horizontality could be maintained, while, by the revolution of the wheel, they could be carried over the bed of coals, baked and returned. The Vienna oven is an Aerotherme, to which two important additions are made: one to admit steam into the oven during the process, so as to maintain a moist atmosphere down to the last few minutes of the baking, and the other a separate fire from which radiant heat, of

great intensity, may be thrown into the oven and reflected from the smooth roof, to almost instantly redden a very thin crust. The cracker bakery is a highly heated trunk, through which an endless metallic apron is made to carry a constantly renewed supply of cracker dough. The baked crackers are as regularly discharged from one end of the trunk as the fresh crackers in dough are introduced at the other.

The Mechanical Bakery.

I will mention only one other invention in this direction. It contemplates the baking of a sufficient amount of bread to supply a city from a single establishment, and was the work of a man whose name is familiar to you from eminent services in the art of war as well as in the arts of peace, Mr. Hiram Berdan. He conceived the idea of an oven which should produce all the loaves of uniform excellence and with a rapidity before unheard of. His apparatus may be described as consisting of two towers filled with heated air, in one of which was an elevator always slowly ascending, and in the other a similar contrivance always slowly descending. On these was arranged a series of platforms with a few inches between, each platform, or huge tray, containing a hundred loaves or more. As each platform attained the summit in one tower it was shot across to the other tower, in which it descended to the bottom and discharged itself. As soon as it was discharged it was shot across to the foot of the ascending tower and refilled with loaves of dough to renew its course. The time of ascending and descending was so arranged as to exactly complete the baking. The whole series of movements of the platform was automatic, and carried on by steam power. Several of these grand ovens—the mechanical bakeries—were constructed in our large cities, and promised at one time to revolutionize the system of city bread baking. Precisely why they did not succeed I do not know. Some of them were destroyed by fire, under circumstances which led the proprietors to think the fires were the work of incendiaries. The establishment first erected in Boston upon the plan of Mr. Berdan was burned, and as an amateur I undertook to find out the cause. I came to the conclusion that it was an instance of spontaneous combustion, arising from the dripping of oil from an axle working in highly heated space, and falling on a mass of heated sawdust. Such cases are unfortunately not rare. Bales of woolen shawls, imperfectly freed of the oil introduced in manufacture, have taken fire spontaneously. Piles of cotton-waste, cotton saturated with oil, and heaps

of shavings saturated with varnish have often been consumed in the same manner.

DIFFERENCE BETWEEN BAKING AND BOILING.

A word or two of definition and I shall proceed to the subject of making bread. Baking, roasting, broiling, toasting, frying, stewing and boiling are all processes of cooking. In what do they differ? In *boiling*, the article of food is subjected to a temperature not exceeding 212 deg., the boiling point of water. In *frying*, it is subjected to the temperature of boiling fat or oil, which may be 500 deg. or 600 deg., the boiling point of the fat or oil employed. In baking, roasting, broiling and toasting, the interior temperature rarely exceeds 212 deg., but the exterior temperature may be 400 deg., or 600 deg., or 800 deg. In these, destructive distillation yields carbo-hydrogens, which are agreeable to the palate, and which are allied in composition to oil of peppermint, cloves, pepper, rose oil, &c. Stewing is in the main a prolonged boiling with a small quantity of water, in which the juices are extracted and subjected to a modification by heat, which they could not experience when shut up in the body of the meat. But I must hasten to the art of making bread.

BREAD FROM WHEAT—SPECIAL VALUE OF WHEAT.

Of all the cereals wheat is best suited to the wants of man. It contains principles of nutrition admirably adapted to the human organism. One portion enters into the composition of the vital tissues, and another subserves the purposes of fuel in providing warmth and force. Health may be preserved upon a diet of bread alone. The grain can be preserved indefinitely long in sound condition, with but little care. Alexander prepared the way for his conquest of India by sending forward discreet agents whose duty it was to accumulate wheat (the corn of the ancients) along the line of his contemplated march. Joseph caused it to be stored through seven years of plenty to meet the needs of Egypt through seven years of famine. On lake Constance, in the region of one of the lacustrine villages, there was found, a few years ago, an underground granary, a cement lined *cache*, of great antiquity, containing a hundred bushels of wheat and barley. It illustrated the confidence of the Lacustrians that wheat would keep.

Flour and Bran—Gluten and Starch.

When this grain is crushed as between the stones of a mill there results a reddish gray powder, the whole meal, which is made up of scales and dust. These two products may be separated by bolting, giving on the one hand bran, divided in England into several grades of toppings, pollard, etc., and in this country into connell, shorts, spouts, coarse and fine middlings, etc., and on the other hand, fine flour. If the fine flour be intimately mixed with a small quantity of water it constitutes the elastic, somewhat tenacious, substance, with which we are familiar in the form of dough. If this dough be kneaded in a gentle stream of water, the water will become milky, and if the water be received in a jar there will settle out a white powder. If the washing be continued at length, the water will cease to be milky and we shall have remaining a tough, highly elastic body, somewhat like India rubber, known as gluten. The white powder that has been separated is starch. The gluten has been separated by chemists into several bodies which have very nearly the same constitution, but which differ from each other somewhat in properties. These are albumen, mucin, gliadine, conceived to be the particularly elastic constituent, and cerealine, to which Mègè Mouriès ascribed a special susceptibility to fermentation. For convenience we may regard them as various forms of more or less perfect gluten. All of them contain nitrogen and phosphoric acid, and beside carbon, hydrogen and oxygen. Starch contains only carbon, hydrogen, and oxygen. Beside the gluten and starch, the wheat contains a little sugar and oil.

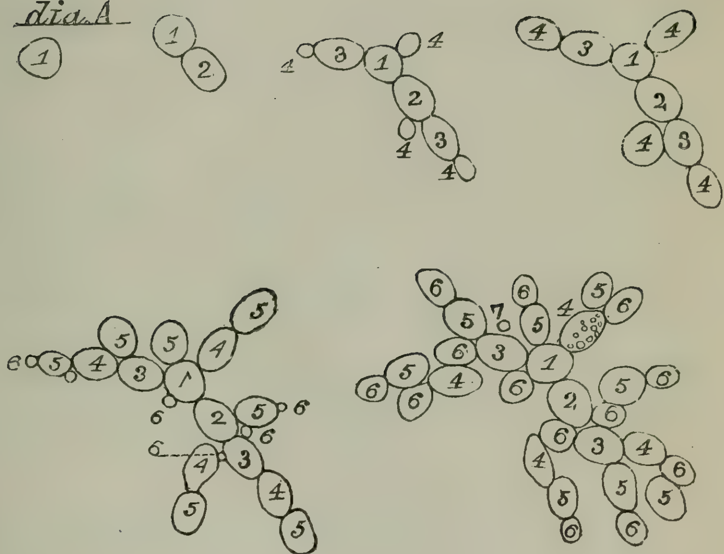
Fermentation—Different Kinds.

The chemical properties of these two bodies—gluten and starch—are in the highest degree unlike. An acid like vinegar or lactic acid (the acid of sour milk), will deprive the gluten of its elasticity, and in time convert it into a fluid. Left to itself, with a small quantity of water, the gluten goes over spontaneously into a variety of less complex bodies, yielding carbonic acid, phosphate, lactate and acetate of ammonia, and some less familiar bodies, leucin and tyrosin, and some volatile sulphur compounds. In time, indeed, it will become a perfectly transparent fluid. Starch by itself would not change, but in contact with the gluten, as in flour, it would, under certain conditions of temperature and moisture, yield dextrine (gum) which would become sugar, and the sugar alcohol and carbonic acid, and the

alcohol acetic acid. Besides these there are sometimes produced lactic acid, benzoic acid, formic acid, succinic acid, and glycerine. These changes take place in the process which we know as fermentation. When one of them, the change that yields carbonic acid (which is a gas) predominates, the mass of moistened flour becomes filled with bubbles. If the quantity of flour is large relatively to the water with which it is mixed, the tenacity of the moistened flour—the dough—will restrain the bubble, and so increase the volume of the dough. Now if, in this inflated condition, the dough be placed in a hot oven, so as to arch over the outside with a stiff crust, and heat the mass throughout, we shall have a loaf of raised bread. But it will be very inferior, mainly for the reason that too many results of fermentation have taken place. It will contain substances objectionable both to taste and smell. We need only one of these results—the *porous structure.* But we have in the dough in question the results of perhaps half-a-dozen different kinds. Let me enumerate them. Chemists have recognized the lactic fermentation, which yields more especially lactic acid; the mucous fermentation, yielding mucilage, or dextrine, or gum; the saccharine, which yields sugar; the alcoholic, or vinous, which yields alcohol and carbonic acid; the acetic, yielding acetic acid or vinegar; the butyric, yielding butyric acid; and the putrid, yielding offensive products. Besides these, there accompanies the saccharine fermentation in bread what has been called an ammoniacal fermentation, during which the dough is dark colored; and the vinous yields, beside alcohol and carbonic acid, certain agreeable essential oils known as boquet or aroma. Lactic acid abounds in putrid fermentation. Now, extraordinary as this must appear, that flour is capable of these changes, there is one thing more extraordinary, if possible, in this connection; and that is, that each type of fermentation is attended by a special organic growth, its particular ferment or yeast organism. In the acetic and putrid fermentations there are animal organisms, while in the mucous, saccharine, and alcoholic fermentations the organisms are vegetable. These organisms feed on the ingredients of the flour to reproduce themselves, and at the same time there are produced the chemical compounds due to the particular kind of fermentation. Here is a diagram of the ferment that attends the production of alcohol and carbonic acid, prepared by the late Prof. Mitscherlich, of Berlin. It presents the growth of the yeast plant from hour to hour. (Diagram A.)

I have said that each ferment plant reproduces itself. It can do

Dia. A



this only at the expense of bodies containing phosphoric acid and ammonia, like gluten. Now, bearing this in mind, you will see how it is possible to eliminate the bad effect of ferment. Instead of setting aside the whole moistened flour to ferment, you will take a small portion of a fermenting mass, the sour dough, full of germs of ferment, and immerse it in material capable of yielding desirable products, in starch, or gum, or sugar, as barley malt, or the starch of boiled potatoes, in which there is a small amount of nitrogenous and phosphatic ingredients, capable of feeding the yeast plant. The dextrine, sugar and alcoholic ferments we want; but we do not want the acetic, or butyric or putrid ferments. We must pass through the ammoniacal, which attends the saccharine fermentation. It ceases at the commencement of the alcoholic. The acetic, butyric, putrid, and one form of the lactic fermentations follow the alcoholic. Our art then must be to avoid the lactic fermentation due to low temperature at the outset. Start with the dextrine or mucous fermentation, and go on steadily through the saccharine and its accompanying phase of the ammoniacal, to the height of the alcoholic, when the ammoniacal will be at an end, and stop before the acetic sets in. Patience, and watchfulness, and science, within the bakery as well as out of it, have accomplished this. The baker diluted the ferment largely with dextrine, sugar or starch, which would give especial activity to the ferments resulting in alcohol and carbonic acid, and sought to isolate the yeast plant suited to this object.

Distillers' and Brewers' Yeast.

You have all heard of brewers' or distillers' yeast. Let me tell you how they are produced. When a mass of ground rye, or corn, or wheat, is brought with warm water and the addition of a small quantity of yeast to a lively fermenation, the froth is skimmed off and repeatedly washed in large volumes of cold water, from which there settles out a fine white powder. This is the yeast plant of the distilleries. If the wheat, or rye, or corn, was sound, the yeast plant will be suited to bread fermentation, but if it was sour, or in any way defective, the yeast plant will carry the taint to the dough. The brewers' yeast is made with more care; crushed rye is mixed with malt meal and fermented. The malt, as you know, is made from barley which has been steeped in water, allowed to germinate to consume most of its gluten or diastase, and convert its starch into dextrine and sugar, and then roasted to arrest the germination. Of course, the mixture of

rye and malt contain relatively less gluten and more gum and sugar than pure rye or wheat meal. The foam from this fermenting mass, washed and pressed, is largely made at Rotterdam and exported to England, under the name of German *barm.* This substance is known to us, mixed with bran and dried, under the name of yeast-cakes. These forms of ferment have the advantage, that they be made comparatively pure, that is, composed of the yeast plants that will yield alcohol and carbonic acid. When mixed with a large quantity of boiled potatoes (chiefly starch), they will yield precisely what is wanted to puff the bread up, make it light, and impart to it a delicious aroma that leaves nothing to be desired. But to secure this result, what must you be sure to do? As the acetic and putrid fermentations follow closely on the alcoholic, you cannot rely on your potato-yeast as a source of leavening for more than a very few days. You must be prepared to renew it frequently. The dough must not be allowed to cool, but must be maintained at an even temperature of some 80 deg. to 90 deg., and when it has attained the requisite porosity, and before acetic fermentation sets, it must be placed in a hot oven. If neglected, so as to permit the formation of either acetic or lactic acid, the gluten will be liquified more or less, its tenacity will be lost, and the bubbles will run together, producing a few large instead of numerous small pores, and the dough will be liable to collapse, and become heavy and sodden.

Alcoholic Fermentation.

I assume that you have the genuine yeast plant, suited, with proper care, to the ultimate production of alcohol and carbonic acid, and these alone; but when you take into account what shocking compounds are sometimes produced, as beer, or ale, or whisky, and the susceptibilities of ferment to the influences of temperature and time, you will readily understand that the pure yeast plant is rather ideal than actual. There is an amusing prejudice in some parts of our country, not wholly confined to the less informed portions of communities, on the subject of alcoholic fermentation in bread. In a report on bread, prepared a few years ago by a generally well informed gentleman, who happened to be a clergyman of Massachusetts, for an annual agricultural festival, the chairman dwelt upon the duty of every young lady to know how to make good bread. It was quite easy. It required attention to only two or three particulars: there must be good flour, a hot oven, and the fermentation must be care-

fully watched. It must be stopped at the *right point*, by putting the bread in the oven, and the right point was *just before any alcohol was produced.* This recalls the advertisement of a baker in London, many years ago, who had heard for the first time that alcohol is a product of panary fermentation. He advertised that bread baked by him contained none of the alcohol produced in the ordinary process of fermented bread. He was followed, a few days later, by a rival who announced that he took no pains to remove from his bread the alcohol produced in the process of fermentation. (It is to be presumed that these establishments preceded the "United Metropolitan Hot Muffin and Crumpet Baking and Punctual Delivery Company.") The quantity of this important product, though small in the individual loaf, is, in the aggregate, large. Liebig estimates the annual amount in all Germany at not less than 7,500,000 gallons per annum.

DIFFICULTIES OF GETTING GOOD FLOUR AND GOOD BREAD.

You do not need to be reminded that with the philosophy of good yeast bread, however clear before you, the ideal loaf cannot be made without good flour. The proportion of this, unfortunately, is small. The wheat runs the gauntlet from the day it is lodged in the ground. If it escapes the birds and is permitted to germinate, the soil may be wanting in nourishment, or the winter frost may snap the tender roots and delay the vegetation in spring, or it may be deluged with rains or scorched and blanched with continuous sunshine and drought; or preyed upon by the weevil or Hessian fly; or smitten with rust at the critical instant when its organic activities are at the highest; or caught by showers in the shock and "grown" in the sheaf; or not sufficiently dry when it goes to the market; or soured in the granary; or heated in grinding; or it may become sour, and lumpy, and musty in the barrel. After having escaped all these dangers it is dreadful to think of its being poisoned by putrid yeast, or overtaken by a warm dog-day atmosphere, which is fatal to the best yeast, or forgotten when passing through the critical stages of fermentation and baking. It is not to be wondered that science has been invoked to preserve to us this invaluable grain and conduct it through the changes that are to give us bread. Thenard, Bossingault, Dumas, Payen, Mègemouriès, and others in France; Liêbig, Knapp, Krocker, Mitscherlich, and others in Germany, and Thompson, Hassall, Pereira, Dauglish, Odling, and others in England, have lent their aid. The best bread

of Paris, Vienna,* and London, may be regarded as in some degree the fruit of this labor, though the larger share of the credit is due to the bakers and skillful housewives who have mastered the unwritten science and art that lie at the foundation of their success. But there is a class of difficulties which baffle the efforts of scientific men to remove. I have mentioned the scarcity of good flour. The best of bread, like the best of anything is costly. There is the intelligence of the cook, which may be of a high order, and yet may be less important than fidelity to the rules of the art of making bread. There must be good yeast. The flour, and water, and yeast must be thoroughly kneaded. An apparatus, driven by steam power, was invented by Mr. Clayton, of England, suited to a large bakery; but the human hand is more than a match for it, in excellence of product, and the kneading trough has the advantage of simplicity. The late President Felton, of Harvard College, used to relate that when traveling in Albania, he came with his guide upon a mountain hut, through the door of which he saw a woman rocking her infant in a wooden trough. The guide asked for refreshment. The baby was instantly rolled out upon the floor, a measure of flour and another of water were poured into the trough, and speedily fashioned into a loaf, to be placed upon the hearthstone to bake. Mr. Felton said the bread was eaten with a relish, but he was puzzled for a long time with a metaphysical problem which arose at the time, and which he had never been able satisfactorily to solve, "Whether he had seen flour and water fashioned into dough in a cradle or a baby rocked in a kneading-trough."

USE OF ALUM, BLUE VITRIOL, AND LIME WATER.

I was speaking of the difficulties of obtaining good yeast bread. The bubbles produced by fermentation sometimes run together, as I

* A friend has said to me that he hoped I would tell how the famous Vienna white bread is made. In the first place, great care is taken in the preparation of the flour. Scrupulous neatness and cleanliness are observed in all the processes of preparing the yeast and dough. The dough is placed in an oven somewhat of the type of the aerotherme—that is surrounded by currents of heated air, maintaining a uniform temperature of about 380 deg. By an arrangement of steam pipes, jets of steam are introduced into the oven to maintain an atmosphere saturated with moisture, and so retard the evaporation of water from the loaf during all the early part of the baking. When the loaf has attained its fullest distension and is penetrated by myriads of minute pores, the steam is shut off, and a side door, communicating with a separate fire from that which heats the oven, is opened. From this the heat of an intense blaze is flashed into the oven to be reflected from the low, glazed tile roof, and give that exquisite delicate red tint to the surface, so much admired, and at the same time charge the thin crust with an aroma which is the product of roasting—an essential oil—most grateful to the palate. This part of the operation is brief, and is watched through a glass window. When complete the loaves are taken from the tins and immediately varnished with warm milk, or water, with which a little good melted butter has been incorporated. The water of the milk quickly evaporates, and leaves a fine glazed surface.

have said, the gluten having become semi-fluid. Alum has been and is largely used to prevent this change. It stiffens the gluten. It is possible, also, that it serves to neutralize the ammonia that attends saccharine fermentation, and prevent the darkening affect of the alkali on the bread. Sulphate of copper has been used—a more active poison. Liebig proposed the use of lime-water, which is harmless, and accomplishes the same end of stiffening the gluten. There is the habit of having the dough wait on the oven, whereas the oven should be hot and the dough in proper condition at the same instant. Then there is the weary brain which may fail to respond to the necessities of the loaf, if it is to be good. All or most of these difficulties attend on achieving with yeast the single quality of cellular structure in the loaf.

Substitutes for Ferment..

The chemist, satisfied of this truth, turned his attention, long ago, to affecting this result by more purely chemical means. Half a century since, and more, bicarbonate of soda was intimately mixed with flour, and this mixture wet into dough with diluted hydrochloric acid. This gave carbonic acid to puff up the dough and common salt to flavor the bread. Dr. Whiting, of England, worked to improve this process, and Dr. Thompson estimated the saving of flour by avoiding the loss due to fermentation at from eight to ten per cent. Mr. Sewall, in 1848, mixed one per cent of strong hydrochloric acid with flour, and an equivalent of bicarbonate of soda. This mixture was a self-raising flour, which would keep for some days. Liebig has recently proposed these ingredients to improve the black rye and wheat bread of Germany. Long ago, sour milk (lactic acid) and alkaline carbonates were used in this country to make quick bread and biscuit. There was a difficulty in this mode, in that the sour milk was not always uniformly acid, and there was a chance of an excess of alkaline, which discolored the bread. Many years since, tartaric acid was used, and more recently cream tartar—another form of tartaric acid—has come into extensive use as a substitute for the muriatic or hydrochloric acid. These acids all act to withdraw the alkali from the carbonate, and liberate carbonic acid. This formula will illustrate the action of the acid: Hydrochloric acid plus carbonate of soda equals chloride of sodium (common salt) plus carbonic acid. Tartaric acid would give tartrate of soda and carbonic acid; and lactic acid, lactate of soda and carbonic acid. Some of these forms of

leavening agents are familiar to you under the name of yeast powders or baking powders. The baking powders composed of pure cream tartar and bicarbonate of soda are of great convenience, and trust-worthy.

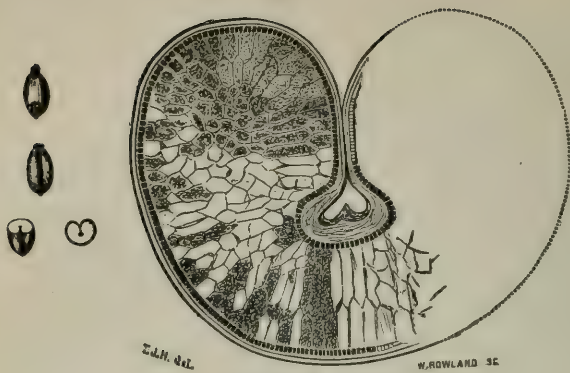
AERATED BREAD.

Another method of securing the cellular structure to the loaf, was perfected by Dr. Dauglish, of London. He kneaded the dough under pressure, with water charged with carbonic acid, soda water. On issuing from the kneading machine the loaves expanded, from the diminished pressure and expanded still more on being placed in the oven, to which they were immediately consigned. Made from thoroughly good, fresh flour, this bread is very palatable, but it competes at a disadvantage, with the yeast baker, since he can disguise the must of inferior flour with the odors of his ferment; and thus produce a cheaper bread.

THE NEW METHOD.

I have now to invite your attention to an invention which has occupied many years of time, and involved much of thought, not to say of more material agencies to develop, and as you might think me disposed to take advantage of the author, if I concealed his name from you, I propose to treat him as I have his scientific brethren, and say that somewhere in 1852 I commenced a series of researches, which have resulted in what I believe to be a valuable addition to the art of making bread. It is well known, that bread made from unbolted meal is more nutritious than bread made from fine flour. Analysis shows us why, If we examine with the aid of the chemist, the tissues and juices of the body, we find, with the great German savan, not only is it true that "Ohne phosphor, kein gedanke," without phosphorus there is no thought; but more than this: *without phosphoric acid there is no life.* Every animal tissue, when burned, yields phosphoric acid. This is true, not alone of the bones and the teeth, but of the muscles, the secretory organs, the basement membrane, the connective tissues, the brain, spinal cord, and nerves, and the plastic juices. This phosphoric acid is wasted with every effort. "While we think we die." The phosphoric acid must be renewed through food. Wheat contains it. Nearly fifty per cent of its ashes is phosphoric acid. But the finer flour contains relatively but little. Meyer, a German chemist, to whom we are indebted for the most exhaustive research on this subject, gives to common millers' bran fourteen times

Fig. 1.



Dia. B.

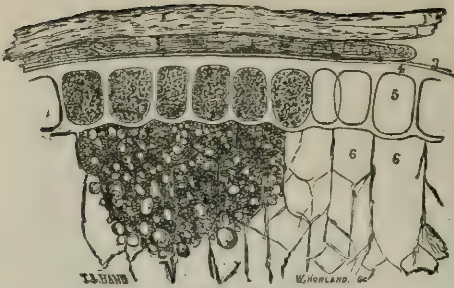
Dia. B exhibits the wheat-grain or kernel of the natural size, presenting the grooved side and reverse, and cross section; also a cross section magnified to 18 diameters, and displaying the bran-coats, gluten-coat and starch-cells.

Fig. 4.

Dia. C.

Dia. C exhibits the arrangement of the successive coats, including the gluten and gluten-cells, more or less of each coat being removed, so as to display the order of succession. Magnified to 150 diameters. The coats 1 1 are readily separated with a moist cloth.

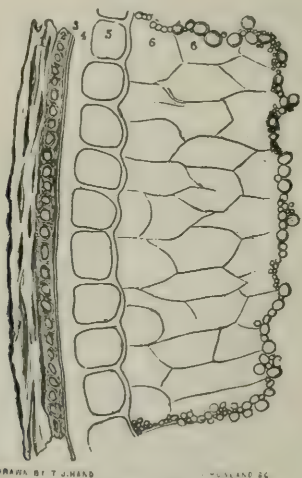
Fig. 2.



Dia. D.

Dia. D presents a portion of a transverse section of white wheat, magnified to 150 diameters. 1 1 are the coats of outer true bran; 2 is the inner coat of true bran; 3 is a thin filmy coat covering the gluten-cells; 4, cellulose containing gluten; 5, sacs of gluten; 6, starch-cells.

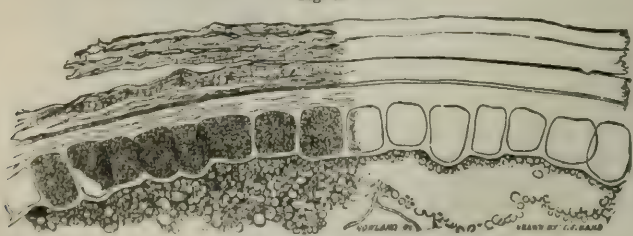
Fig. 5.



Dia. F.

Outline drawing of a portion of a *longitudinal* section of *Miller's Bran*, upon a scale of 150 diameters. This is an accurate drawing, under a camera lucida, and shows the great loss of nutritious matter in ordinary *Miller's Bran*. 1, outer true bran; 2, inner true bran; 3, thin membranous coat: 4, coat containing gluten-cells; 5, gluten-sacs, in outline; 6 6, starch-cells, in outline.

Fig. 3.



This is a companion drawing to Fig. 5. and presents a *transverse* section of *Miller's Bran*.

as much phosphoric acid as is found in an equal weight of fine flour. Let us see why this should be so.

If you cut a grain of wheat in halves, at right-angles to its length, and expose the fresh surface to the action of a solution of a salt of copper as ammonio-sulphate of copper, after a few hours you will observe that a narrow belt very near the outside of the section exposed by the knife has become green. This green is due to the formation of *phosphate of copper.* Within this belt or circlet of beads the color will have been very slightly changed; the phosphoric acid and the gluten of which it is a part, are confined to this layer near the envelope. If you moisten plump grains of wheat and rub them between the folds of a coarse towel, you will, in a little time, separate from each berry a thin, straw-like envelope, which contains little or no nutritive material. This is the outer, true bran. If you examine the layer next beneath, you will find it composed of tubular bundles, laid side by side like cigars spread out on a table. It has been called the cigar coat, and is the inner, true bran. Next within is a delicate gauze-like coat, not continuous, and very thin; and beyond is a layer smooth on the outside, but filled on the inside with cells, that suggest a honey comb, a single layer of cells in thickness. These cells are occupied, each with a little sack containing gluten, and constitute the gluten coat, seen as a row of beads in the section just described. Beyond the gluten coat to the heart of the grain is a mass of starch granules, supported in an open texture of cellular tissue. These diagrams will illustrate the succession of coats. (Diagram B and C, and explanation.)

Here is a diagram of a section of miller's bran, more magnified, and another made at right angles to the first, in which you have the cigar tubes opened by the slicing of the knife. (Diagram D and E, and explanation.)

If you expose the cross section of the berry to the action of a solution of iodine, you will find that all within the row of beads of gluten will become blue. This is the characteristic reaction of starch. The gluten you have noticed is confined to the envelope of the grain, and you will see at once why, in grinding and bolting, the adhesion of the gluten layer to the outer coats of bran proper should cause it to be separated from the fine flour in bolting. But a small proportion of the phosphatic ingredients is found in the starch, so that most of the gluten which the fine flour contains is due to the partial

crushing of the gluten coat, by which portions of it are made fine enough to pass through the bolt, to be mingled with the flour.

IMPORTANCE OF PHOSPHORIC ACID IN BREAD.

Important as this phosphoric acid is — as shown from the superior healthfulness of bread made from whole meal — of the pumper-nickel of Westphalia, which is made of whole meal of rye and wheat, and of the black bread of the Prussian, Austrian, and Russian peasantry and soldiers; and useful as it is known to be as a remedial agent, where the food is deficient in phosphates; important as its presence in food is, it was obviously of great moment to attempt its restoration to fine flour. Since my labors began in this field, Mègè Mouriès and others, in Europe, have attempted to extract the gluten as a whole, and incorporate it with the flour in the process of making fermented bread. The task was beset with numerous difficulties, involving, among other things, a mill and bakery in the same establishment, and has met with little success. I conceived the idea of obtaining the phosphoric acid in the form of a powder that should be without attraction for atmospheric moisture, and which could be mixed with its equivalent of bicarbonate of soda, and then with flour, so that on stirring the prepared flour with water the phosphoric acid should dissolve and combine with the soda, and thus liberate the carbonic acid to inflate the dough. Could this idea be carried out, I foresaw that there would be gained all the conveniences of quick bread, the annoyances and uncertainties of making good bread in the use of yeast would be averted, and the most important nutritive principle of the wheat, which has in great measure been lost in bolting, would be restored to the flour and to the bread. Let me take a moment to stir some self-leavening flour and water together for a loaf of bread, and place it in the oven.

NEW DISCOVERY.

While the sample is baking, I will mention a discovery I have made during the last summer, which bears upon the significance of phosphoric acid. Two or three years ago Liebreich, a German chemist, discovered that the crystallized fatty body obtained by treating the brain with alcohol is a grand phosphate in which there is present beside phosphoric acid, cerebrin—a peculiar fatty body containing nitrogen—olein, margarin, and stearin, with which you are all familiar as constituents of tallow, lard or butter, glycerine, and a curious ammonia in which one atom of hydrogen is replaced by the radical

of alcohol, and the other three by three molecules of the radical of wood spirit, a kind of alcohol. This remarkably complex body has been found in the yellow of the egg, and in the blood corpuscles and plasma, and in some grains. The discoverer called it protagon. As this body is an important constituent of the brain, it occurred to me that as the chicken must derive the protagon of its brain from the yolk of the egg, the calf must derive the protagon of its brain from the milk of the cow, and I ought to find it in the oily constituent of the milk, namely in the butter. I selected a fine sample of butter, dissolved it in ether, leaving behind the salts of the milk and any lingering casein and sugar of the buttermilk, and examined the ether solution for phosphoric acid. My expectations were realized. I found phosphoric acid. It was natural now to look in the ethereal extract of green grass and clover on which the cows feed. I did, and found phosphoric acid. I then pushed my examinations to the green leaves of vines, flowering plants, shrubs, fruit and ornamental trees, and finding phosphoric acid everywhere in the ether extract of green leaves, I came to the conclusion that phosphoric acid is a normal constituent of chlorophyl as well as of butter. The chlorophyl of the leaves has long been regarded as the chief seat of the agencies which produce the vegetable organism, and no one can doubt the important share the phosphoric acid plays in it. The advantage of turning under a clover crop to give fertility to a soil seemed to have a new explanation. So, too, the value of a compost of leaves, or forest mould. The value of phosphatic fertilizers has long been known. Now, if phosphoric acid is so important to the vegetable organism, it no longer surprises us that it is so universally present in animal tissues and juices, and so essential a constituent of food. But I must return.

Self-leavening Flour.

I found that phosphoric acid, by combining with it a small proportion of lime, might be placed in a condition to have no affinity for atmospheric moisture, and thus by diluting it with a dry powder, like starch, it might easily be made pulverulent, and then as a powder intimately mixed with flour. When, to this flour, bicarbonate of soda was added, in quantities sufficient to neutralize the phosphoric acid, and the whole was intimately mixed, there was produced what might be called self-raising or self-leavening flour. On stirring this prepared flour with water, the phosphoric acid would dissolve and combine with the soda to liberate the carbonic acid and puff up the dough,

leaving phosphates of lime and soda in the bread. There remained one thing more. The phosphoric acid in the normal wheat is largely combined with potassa. Of the ash which burned wheat leaves, nearly fifty per cent is phosphoric acid, and about thirty per cent is potassa, with small amounts, relatively, of lime, magnesia, soda, silica, and iron. That my self-leavening flour might contain phosphate of potassa, I prepared my phosphoric acid, in combination with potassa and lime, or taking the acid phosphate of lime I added chloride of potassum to the self-leavening flour, which, besides furnishing phosphate of potassa on the addition of water, set free hydrochloric acid. The hydrochloric acid being more soluble, acted more promptly on the bicarbonate of soda, producing chloride of sodium (common salt), and setting free the carbonic acid to inflate the dough. Thus constituted, the self-raising flour has, in most respects, very nearly the nutritive value of the normal wheat, without the inferior color, and the liability to rapidly sour of the whole wheaten meal. You will pardon me, I am sure, if I read to you an extract from a letter of Baron Liebig, to whom the world is more indebted than to any living scientific man, and who has given great attention to this subject. He wrote me some time since as follows: "*I consider this one of the most useful gifts which science has made to mankind. It is certain that the nutritive value of flour will be increased ten per cent by your phosphatic bread preparation, and the result is precisely the same as if the fertility of our wheat fields had been increased by that amount. What a wonderful result is this!*"

Obscure Phenomena of Bread.

While my bread continues to bake, let me direct your attention to two or three points, which have been regarded as obscure, but which it has been my fortune in some degree to clear up. What are the changes that attend the conversion of flour into bread? We have already seen that the flour is composed of gluten and starch, and glanced at the changes produced by fermentation. When starch is examined with the microscope, it is found to consist of little sacs, sometimes groups of them aggregated together, which sacs are composed of homogeneous membrane, suggesting collodion in appearance, within which the granules of starch proper are deposited. If you subject these starch sacs to heat, they burst open, and then if the starch granules come in contact with water, they liquify to form fluid starch, a sort of mucilage. These diagrams will illustrate what I have said. (Diagram F.) If, in this condition of mucilage, the starch be

dia.F

permitted to dry down, it leaves a hard, transparent, glassy substance, which requires considerable time to again dissolve in water. Now, this is true, whether the change occurs within the loaf or without. We see at once the necessity of heating the loaf, in the process of baking, to a temperature of 212 deg. throughout. The starch sacs must be burst, and the starch granules moistened and resolved into mucilage, to render the bread palatable. The heat must penetrate throughout the loaf to expand the gas bubbles, and thus increase the lightness of the bread, and, finally, it is essential to arrest and destroy the ferment. But what does the heat do to the outside of the loaf? It dehydrates and stiffens the gluten, of course. But it does more. It roasts the gluten and starch at and near the surface, giving rise to grateful aromas and a beautiful reddish tint, if not carried too far. The starch becomes dextrine, or British gum, and the loaf is arched over to prevent the collapsing of the loaf, which heat and the last effects of fermentation have expanded to its full capacity. Some chemists have ascribed the delicate red tint, which carefully regulated heat will produce on bread and pastry, to *assamar*, a body discovered by Reichenbach. I once obtained a liquid of an exquisite rosanaline color, by heating, to the temperature of destructive distillation, a mixture of dried flour with soda lime. It is probable that this body, whatever it may be, is present in the crust of bread.

Dextrine or Gum in the Crust.

You all know, or, at least, all who have ever had anything to do with the baking of bread, how hazardous it is to leave a loaf in the baking tin after it is taken from the oven. It should be instantly removed, as you are aware, since if this is neglected, the surface of the loaf becomes moist and adhesive. This is due to the formation of roasted starch or British gum in the crust. At the conclusion of the baking process the loaf is exhaling steam. If it remains in the pan, as the latter cools, the steam condenses to water at the surface of the loaf, and liquifies the roasted starch, converting it into mucilage. The adhesive nature of this substance, which makes it so useful in the arts, was discovered, it is said, by accident. A flouring mill somewhere in England burned down, and quantities of wheat were roasted. It was noticed that the water that drained away from one of the piles of roasted wheat was sticky. When the British government instituted the penny post and the use of letter-stamps, the post-office department used this mucilage to secure the adhesion of the

stamps. This was a great convenience, and some persons to whom, as to, the general public, the nature of the adhesive material was not known, sought to find out the secret. The government officers were reticent. At length an enterprizing contributor to a provincial newspaper announced that an analysis of the material had revealed in the stamps the presence of — arsenic! The newspaper article ran the rounds of the press, and so alarmed the people who had been innocently applying their tongues to the gummed surfaces, that the Government was compelled to come out with the statement that the preparation was simply British gum.

What is Stale Bread?

There is a peculiar quality which bread acquires after a day or two which we recognize in calling it *stale.* It is said to be more healthy than fresh bread. Such bread may be freshened by placing it for a few moments in an oven, or by toasting. Let me tell you why it is believed to be more healthy, though less palatable. Fermented bread, at the temperature of 212 deg. still contains the germs of ferment. If taken into a sensitive stomach while still warm, it is conceived that some of these ferment producing spores or seeds find their way into the circulation, and there produce decomposition of surrounding fluids. These phenomena of fermentation are conceived to be mainly dynamic—that is, one complex body falling apart communicates a blow to a neighboring complex body and separates it into less complex forms. This is no more true of the effect of ferment in the percussion which flashes sugar into alcohol and carbonic acid than, it is believed, it is of ferment in breaking up the delicate and elaborate organic compounds which are built up in the processes of digestion. If the bread be left to dry and become cold, most of these germs of ferment plants die. In a moist and *warm* place they continue to live much longer, and, besides, the bread becomes covered with and penetrated by mold, which is a kindred vegetable organism. I may mention that bread made from self-leavened flour, without the use of ferment, may be eaten while fresh and hot with impunity. It is no more likely to do harm to any digestive apparatus, however sensitive, than hot beefsteak. Moreover, it is much less liable to mold in damp weather. But what is stale bread? Boussingault, some years ago, undertook the solution of this problem. He first showed that to become stale was not necessarily, as had been previously supposed, attended with a loss of weight, as of water. He

cooled bread in hermetically sealed spaces and it became stale. He then sealed stale bread in a metallic tube and heated it. It became fresh, and again stale on cooling. He repeated the process, in all forty times, with the same sample, alternately heating and cooling, and with the last heating it became fresh, and with the last cooling it became stale. He concluded from his experiments that there was what he called a molecular change taking place in the crumb when it became stale, and again when it became fresh, and he thought he had explained it. Thenard, who listened to Boussingault's paper before the Academy, suggested that bread was a hydrate, from which water was driven out by heat, and reabsorbed on cooling. But it would seem, according to this view, that fresh bread, to the taste, should be the dryer of the two. Neither explanation was satisfactory. When I found that gluten was a hydrate, from which a moderate heat would expel water, and that, on cooling, this water was again taken into the constitution of the gluten, I applied this fact to the solution of the problem. The stale crumb may be regarded as a framework of gluten coated with glassy dried starch, which is not readily dissolved by saliva. Of course, when taken into the mouth, it requires time before it becomes flexible, and can be easily compressed to force out the fluids it takes up in the mouth by virtue of its capillary action. But by heating, the water of hydration of the gluten is driven out, the starch which invests the gluten is moistened and rendered flexible, and the whole crumb, recovering the sponge-like elasticity of fresh bread, yields its juices when masticated, and is palatable. To test this, I placed in a glass tube a quantity of gluten, and sealed it up. I then placed the end containing the gluten in warm water, and beheld, a few moments later, moisture condense on the interior of the upper end of the tube, which was cool. On withdrawing the tube from the water, after a few hours, the film of moisture had disappeared. Water had been driven out from the gluten by heat, and had been reabsorbed on cooling. I then placed another quantity of gluten in the bottom of a tube, above it a tuft of cotton, and above the cotton a quantity of loose shavings of very thin glacial starch. Now I expected that if moisture was given off from the gluten, it would penetrate to the space occupied by the shavings, half liquify the starch, and make it adhesive. In this condition the starch shavings would be gummed fast to the glass, and it would no longer be possible to shake them about. The experiment realized my expectations. The solution, then, of the question of the difference between stale and

fresh bread, is this: *The gluten is dehydrated by heat in freshening, and the water driven out, softens the dried starch which coats the gluten. Thus softened the crumb is more palatable. On cooling, the water is withdrawn from the starch, which is rendered dry and stiff in consequence, and restored to the gluten, and the bread becomes stale.*

WHAT IS PILED BREAD?

There is another point which is regarded as quite mysterious. It is what is called *the pile of bread*, and is an evidence of excellence. It is a term familiar to bakers, though possibly not to all my audience. A loaf in which the pile is good may be separated into strips somewhat like the husks that encase an ear of Indian corn, or the coats that invest an onion. How this should appear in a loaf produced from a body apparently so homogeneous as dough is thought very extraordinary. The explanation is simply this: Where the gluten of the flour is unimpared by heat or souring, it retains its tenacity, even when greatly attenuated. When the dough is kneaded, it is spread out and folded over upon itself again and again, from the border toward the center. The surface is repeatedly dusted with flour, until these layers of flour at last, after long, continued kneading, are everywhere present in the loaf, separating thin sheets and strips of the fermented dough, each strip containing fibers of tenacious gluten. Now, this fine flour, by the last act of the ferment, is carried into the mucous stage of fermentation. So that when the loaf is baked there are planes or surfaces of soft mucilage—planes of separation, threading the loaf in the direction from the bottom around the outside toward the center at the top. These permit the loaf to be stripped off somewhat as short pie-crust may be separated into flakes.

HOW MAY GOOD FLOUR BE KNOWN.

You will ask how such good flour as such "piled" bread is made from, may be obtained. The question is not easily answered. But some general guiding principles may be recognized. Wheat should not be cut until it is absolutely ripe. A little may be lost in harvesting, but nothing like what may be lost by cutting it while any portion of the berry is liquid. The moist straw, by its evaporation, draws the fluid out of the berry, and lessens enormously its nutritive value. Cut ten days too early is equivalent to a loss in weight of scarcely less than one-fifth of the whole weight. With thoroughly ripe, well-filled grain there is little difficulty in preparing good flour. But we

must select from the flour which the market affords. Good flour from fully ripe, dry grain, but recently ground, will not contain lumps. These are due to souring, which softens the gluten and sticks the flour together. Good flour will readily mix with water to form a uniform creamy batter. Good flour will yield, with a small amount of water, a tenacious, elastic, homogeneous dough. Good flour will not smell sour or musty, but will exhale a fresh, fruity aroma. It will, when pressed in the hand, retain the imprint of the fingers.

Advantages of Self-leavening Flour.

Let me now return to the self-leavening flour, from which our loaf has been produced. Its chief characteristic is its uniform cellular texture. This is an essential condition of the healthful preparations of farinaceous food. It should be porous, to permit the ready imbibition of the fluids that serve indigestion. The self-leavening flour is the substratum upon which whatever is desirable may be erected. Mixed with water or cold milk, and immediately baked in a hot oven, it gives plain bread. If the tins are small the result is biscuit. Increase the quantity of water, beat in an egg, and spread the paste on a hot plate, and the product is a griddle cake. Add molasses and ginger, and you have gingerbread. Stud the leavened mass with raisins and you have a pudding. Eggs, sugar and flavoring extracts give you a sponge cake. If there be a fancy for the faint, delicate aroma of hops in bread, replace a portion of the water with Scotch ale. If a rich reddish-brown crust to the bread be desired, add a trace of sirup to the milk or water. Will you apply the self-leavening principle to other forms of farinaceous food, mingle the phosphoric acid and the bicarbonate of soda with the corn meal, or rice, or rye, or buckwheat, and the task is accomplished. With the self-leavening agent at command, little time and moderate skill are required to secure uniformly excellent results.

Recipe for making Good Yeast Bread.

Let me conclude by giving you special instructions for making good yeast bread, the philosophy of which, I will hope, will now be easy to comprehend. Select good, plump, fully ripened, hard grained wheat. Have it freshly ground, and not too finely bolted. Prepare the yeast as follows: Boil thoroughly with the skins on, in one quart of water, enough potatoes to make a quart of mashed potatoes. Peel

the boiled potatoes and mash them to fineness; mix intimately with them one pint of flour, and stir the whole to an emulsion with the water in which the potatoes were boiled. Cool the product to about 80 deg. (lukewarmness), and add half a pint of the best fresh baker's yeast, and a tablespoonful of brown sugar. Set aside the mixture at an even temperature of about 80 deg., till it works well, or is in active fermentation. Of this yeast take half a pint to a gallon (7 lbs.) of flour, mixed with three pints of water, or two of water and one of milk, all at the temperature of about 80 deg., add a little salt, knead thoroughly and set aside to rise at the temperature mentioned. When it has risen to nearly the full volume for the dough, divide it into loaves, knead again, set it aside at the temperature already named till it attains the full size of the loaf, and place in an oven heated to not less than 450 deg., or a heat which will slowly brown flour scattered on the bottom of the oven. Let the loaves of dough be smaller than the tins. Keep them covered with flat tin-plates or stiff paper till the dough is fully raised and the heat carried up to and sometime maintained, throughout the loaf at 212 deg., to convert all the starch to the mucilaginous or emulsion condition, and destroy the ferment, then remove the cover, and permit the browning to take place. If the loaves are large a higher temperature will be required. Seven pounds of flour will make eight loaves of 1¼ lb each when baked, or four of 2½ lb each. Such yeast will keep a week in winter and from two to four days in summer. Bread made with it, in faithful obedience to these instructions, will be good.

SCIENTIFIC LECTURE.—VIII.

ON PRIMEVAL CHEMISTRY.

By T. Sterry Hunt, F. R. S.

The eighth lecture of the course before the American Institute, was delivered on Wednesday evening, January 13th, 1869, by Dr T. Sterry Hunt, of Montreal, Canada, at Steinway Hall, subject, Primeval Chemistry. The President of the Institute introduced the lecturer, who said:

Mr. President, and Ladies and Gentlemen: You have already been informed that the subject of this evening's lecture is Primeval Chemistry—the chemistry of the earlier condition of the world's history—chemistry before there were chemists, before there was any eye, except the eye of its great all-seeing One, to investigate or to study His marvelous phenomena. As this has reference more especially to the history of this earth, it may be well spoken of as chemical geology, a term which has been very frequently applied. We speak of geology as if it were a science; but in reality under that name we include a whole group of sciences. In the first place, to the astronomer this world is one of a system revolving around our sun—the so-called solar system—and that so-called solar system is but one of many more such great systems, thus occupying a very insignificant position in the great cosmos. Thus our world appears to the astronomer. To the physicist, again, who studies it in relation to the laws of gravitation, with regard to the laws of light, it appears altogether in another light. Then comes the chemist, who examines the composition of its rocks, its waters and its atmosphere. He has also his history of the globe. Then comes one who studies the changes in its crust, the movements which give rise to mountains, which cause all the geographical diversities of the earth's surface. Later comes a period in the history of the planet, in which life appears upon the surface, animal and vegetable, and already Dr. Dawson has explained to you the laws which govern the evolution of vegetable life, how

during successive periods, successive creations, flora after flora, each more beautiful and more perfect than its predecessor, appear upon the surface of the planet. Then again comes the zoölogist, who investigates the various forms of animal life. All these ages, beautiful and important as they are, are mere hand-maidens to that great complex study which we call geology. Prof. Hunt said he would merely discuss the chemical relations of our globe, but he must to a certain extent go outside of our globe, because we must look at it from the astronomer's point of view. The chemist had to look to the rocks, the waters, and the air but behind all these came in another question, whence was the origin of rocks, or water, and of air? There must have been a time when these were not, and the first question of the student was as to the origin of these things. It was the rare privilege of the scientific eye to look backward, to solve this problem, and to learn as it were, the history of these pre-historic times. To the astronomer, who recognized the fact that our globe was but one of many worlds, there came in a strange and unexpected light to aid us, and physical science here contributed most curious stores of knowledge. Speculating upon the origin of our earth, and seeing the curious harmony which existed between its motions and those of its satellites, and of the other planets that moved around the sun, the great Kant was induced to ascribe a unity of origin to all. Later, the idea was developed by La Place, who supposed that from a great nebulous cloud existing in space there was formed, in accordance with certain physical laws, successive planets successive satellites, the sun finally remaining in the center, the whole the condensation of one immense cloud of vapor, for whose origin still further back we must only look to the great Author of existence, who created it and imposed upon it the laws which, in after ages, regulated its development. This great nebulous cloud rested in this condition until Sir Wm. Herschel, in studying the skies, detected certain masses of light which had before been known as certain cloudy, milky masses of white light. He viewed them with his great telescope, and was unable to resolve them. Here he said, "I have the origin of this cosmic matter; here I really see the stuff of which worlds are made," and he described them as so many nebulæ. Later astronomers looked at the matter with more powerful glasses and were able to resolve many of them into groups of stars. For instance, the great milky-way, which we observed so plainly in a clear, cold winter's night, was found, on close examination, to be made almost entirely of little stars, which

came out under our brightest telescopes. Still there were certain masses of light which Herschel could not resolve, but which other observers discovered to be made up of suns or of stars, and hence the nebulous hypothesis fell into doubt. It was said that still more powerful instruments will enable us to show that these nebulous masses are made up of stars. There came in a very unexpected aid in the spectroscope. With this instrument, in the examination of light in the first place from terrestrial sources, it has been found that you can discriminate between the light that comes from a solid body and the light which comes from a vaporous, gaseous body; that you can pierce distance and resolve problems in the investigation of which the most powerful telescope was impotent. We have now discovered that in the sun and in the fixed stars we have present the very same elements as are those of our earth, and we may thence conclude that the same chemical laws which hold good in our planet hold good in all bodies of the solar system. We might, therefore, conclude not only the unity of our system, but the unity of all systems, and all worlds, and we are enabled by comparison between these and our own planet to show that all these nebula, suns and planets are worlds in so many successive stages of development, of which our own makes perhaps one of the latest and most completely accomplished stages. Having this great luminous or nebulous mass, the natural inquiry was what were the laws which regulated its condensation, how should it ever become reduced to the condition of a solid globe? By the simple process of cooling. The sun, the great center of our system, was a cooling body. It was a body constantly giving off light and heat, constantly losing light and heat, and therefore slowly but surely undergoing a cooling process. When we investigate the laws of cooling bodies, and still more when we investigate the chemical changes in bodies at a greatly increased temperature, we learned another curious lesson, which was, that at intense temperatures, such heat as must exist in the sun and in the nebula, almost all bodies are in a state of chemical indifference. He did not know that he could make himself plainly understood, but he would refer to the composition of water. This was known to be produced by the combination of oxygen and hydrogen gases. These, combined with an evolution of heat to produce water, but if you exposed water to a very much higher heat than that by which it was formed, it would break up again into oxygen and hydrogen. So we find that almost all compound bodies known in nature, when intensely heated, are decomposed. It

seemed as though the chemical affinity which brought them together and tended to make them a unit in combination, was completely suspended at these higher temperatures, so that one might suppose that on the sun, and still more in these nebulous bodies, all the elements were in a state of chemical indifference, or in other words, of dissociation. The spectroscope told us that, because we recognized the spectra of the simple elements, and of the compound bodies. The process of condensation which was going on in the sun must be going on in all the planets. Our earth was once a luminous mass of vapor, passing through a stage in which it was self-luminous like the sun, until it finally became cool to such a point that it liquified and became at last solid. The next question is, did the earth become solid first at the circumference or at the center? This is important from more than one point of view, and has been investigated by astronomers, physicists, and chemists, and it seems pretty clearly proved that the earth, if not solid to the center, must have a crust several hundred miles in thickness. And it is probable that if the cooling commenced at the center, that at least the surface would be covered with a thin layer of liquid matter, which, on cooling, would give an uneven surface to the primeval globe. So far as the chemistry of our planet is concerned, we have to deal only with this outer layer, all the various elements of which must have existed either in that crust or in the atmosphere which then surrounded it. We form a good idea of this primeval crust, if we suppose the elements, rocks, air and ocean to be brought together at the intense heat which then existed. Under such conditions the lime, magnesia, alkalies—would all unite into combination with silica and alumina, while the atmosphere would contain chlorine, sulphur, carbon and hydrogen, together with oxygen and nitrogen. This would form on the one hand a slag-like siliceous mass, and on the other hand an atmosphere charged with acid vapors, yielding all the chlorine, sulphur and carbon in the form of acids, and the water in the form of steam mixed with nitrogen and oxygen. The weight of the atmosphere would be immense, and under its pressure water and the less volatile acids would be liquified at the high temperature, and these acid waters would collect in the depressions of the earth's crust, where they would immediately decompose the silicates, separating the silica and forming sulphates and chlorates of the alkalies—lime and magnesia. This solution would form first, sea water, and the action would continue till these affinities were satisfied. Then commenced a new chemical process, the action of

air and water upon the exposed portions of the earth's crust, converting the silica into clay, with carbonates of lime, magnesia, and soda through the action of the carbonic acid of the atmosphere. The soda carried by rains to the sea, decomposes the lime salts, forming carbonate of lime and sea salt. The process is still going on, though more slowly, from the small amount of carbonic acid in the air, and causing the decay in the hearts of granite rocks. We have thus explained the generation of silica or quartz of clay and of limestones, the principle elements of sedimentary rocks. Every clod of clay represents granite rocks decomposed, and an amount of limestone and sea salt, formed from the waters of the ocean. In this way the air was freed from carbonic acid, and fitted for the support of animal life. Besides this, the vegetation removed large portions of carbonic acid, replacing it by oxygen, and the formation of limestone directly diverted still greater amounts of carbonic acid, whose presence must have rendered the early atmosphere unfit for the higher forms of life. The presence of carbonic acid in the early atmosphere serves to explain the higher temperature then prevailing, which permitted the growth of tropical plants within polar circles. We know that a portion of carbonic acid, such as then existed in the air, while it would not prevent the passage of the sun's rays would impede the radiation of obscure heat from the earth's surface, and thus tend to keep up a summer temperature. The effect of this carbonic acid would be like the glass of an orchard-house in preventing the escape of heat. Thus carbonic acid exerted also an important part in many other chemical processes then active at the earth's surface. Besides deposits formed by chemical processes, mechanical operations were forming at the earth's surface a great amount of sandy and clayey rocks, which make up the bulk of the stratified forms. Although the interior of the earth has been regarded as solid, it is notwithstanding doubtless intensely heated, and thus is explained the increase of temperature as we go below the surface. The cooling of this center, once rapid, is now very slow indeed from the thickness of the overlying sediment. The effect of this heat upon the deeply buried sediment has been to crystallize them, and convert them into metamorphic rocks. To this class belongs granite, once looked upon as a primitive rock. We have now evidence that granite is in all cases a secondary rock, derived from sediments crystallized through the agency of water and heat. In the quartz of granite are often found small cavities, partly filled with water, which

are so many small thermometers showing the temperature at which the granite was crystallized. Pressure, which increases the melting point of rock when exposed to fires, greatly favors the dissolving power of heated water, so that we may suppose that the lowest strata of sediment and often adjacent portions of the primal nucleus being permeated with water, under great heat and pressure, became softened and yielding. From this softened zone come all eruptive rocks, and in it are to be found the causes of volcanoes whose various products are generated by the action of heat upon the varied elements of deeply buried sedementary strata. The theory which ascribes volcanic products to the supposed uncooled liquid center, fails entirely to account for the great diversity in composition of these products, all of which, wherever found, are represented in rocks of aqueous origin. The distribution of modern volcanoes shows them to be intimately connected with comparatively recent accumulations of sedimentary rocks; entire absence of volcanic phenomena over the eastern part of this continent is thus explained. The learned lecturer observed, in conclusion: We have endeavored to show some of the results of the chemical and physical laws which presided over the first formation of the globe. We have thus seen in what manner chemical and physical laws operated in giving form and order to chaos, and in producing from the first nebulous mass the various rocks and minerals, the water and the air of the present habitable globe. A further study of these same laws would explain the whole theory of mineral springs, the formation of metallic veins, and the processes connected with the growth and development of life upon our planet.

SCIENTIFIC LECTURE.—IX.

ON THE PHOTOMETER.

BY PROFESSOR R. OGDEN DOREMUS.

Prof. R. Ogden Doremus delivered the ninth lecture of the scientific course before the American Institute on Friday evening, January 22d, 1869, at Steinway Hall. He said :

LADIES AND GENTLEMEN—"In the beginning God created the heavens and the earth, and they were without form and void ; and darkness was upon the face of the profound." What pen shall describe, what tongue shall tell, what human imagination conceive of that tide of glory and splendor, which undulated throughout immensity when God said, "Let light be," and light was ! Such is the most beautiful and terse description offered in that word of God on which the dying Christian blesses the Almighty he can pillow his head, and the burning martyr returns thanks if he can mingle its ashes with his own ! To tell the story of the first light which dawned upon the universe of God, is beyond the power of man. To tell indeed what has been discovered concerning it would extend beyond the short time allotted to a lecture. That light moves through space with the immense velocity of nearly 200,000 miles in a second of time ; that when we look at the sun we gaze at the light that parted from it minutes ago ; that when we look at the stars, no one is so near us but that three and a quarter years have elapsed during the passage of that mysterious influence ; and when we look up on such a beautiful cloudless night as this evening, and see the magnificent scenery of the heavens, that those worlds send us light which started on its march long before we were born, and, in many cases, ages before our race existed upon this world—such are the facts known to modern science. And how shall I tell in the brief limits of a lecture of the power we have, by clear transparent media, to compress these beams, to concentrate these rays, so that we can gain information from the distant realms of space ? Let us not forget the great Italian, Galileo,

who first descried in the heavens that beautiful crescent form of Venus, which was a complete proof of the movement of our planet with the others round the sun, and that beautiful representation of our solar system, Jupiter, with his attendant moons, and Saturn with those extraordinary handles, as they seemed to him. Astronomy had advanced to a point that required that man should be lifted up to the heavens, or that the heavens should be brought down to him; but how could we believe that the simple transparent medium of glass would accomplish this result?

When the brain of man had thus begun to explore the profundities of space, and found that our sun was but a single sun among hosts of others, and that our great astral system was but one of thousands, then did he sing in the words of the Psalmist: "What is man that thou art mindful of him and the son of man that thou visitests him?" The atheist sees in this the contemptible minitude of the earth as compared with the magnitude of the universe. Hence the improbability of Heaven being moved for our salvation. But thanks to the genius of man, we have the response in the microscope, the same transparent medium rounded in different forms, which tells us by its refractive power, as you have heard from the lips of the President of Columbia College, that we have revealed here beauties of configuration which announces that the Almighty has almost expended himself upon this planet. The microscope answers the telescope. The one tells us of Almighty God working in distant realms, so remote that it is hard for imagination to conceive of the distance, and the other of his power in such minitude that it almost surpasses the power of the human brain to embrace the conception of his acts. But were I to tell you of the wonders of the prism, the same medium, glass, being cut in a wedge-form, I should reveal to you other extraordinary powers of the solar ray. We are all familiar with the experiment of Newton, who, when the sunbeam passed through his prism, split it up into its primary colors. He had the red, the yellow, the blue, and the happily blended intermediate tints, the red and the yellow producing orange, the yellow and blue producing green, and beyond these the indigo and the violet, the union of all being requisite for that perfection which we see in pure white light. Furthermore, as will be told you in the next lecture, not only are these various colors produced, but at one extreme of the spectrum we have the heat, and at the other the chemical beam, and in the intermediate one the luminiferous beam, while we have also the phosphorescent rays, and those

that produce that beautiful result of fluorescence, all required to be harmonized to produce that light which we see by day, and which we also see reflected from the moon by night. Let us not forget what we were taught in early childhood, found in the first simple rhymelets that we ever harmonize and study to memorize, from Mother Goose's simple story:

> "A twister in twisting would twist him a twist,
> And twisting his twist, seven twists he doth twist;
> If one twist in twisting untwists from the twist,
> The twist, untwisting, untwists from the twist."

The same has been thus happily paraphased:

> "A raveled rainbow overhead,
> Lets down to life its varying thread;
> Love's blue, Joy's gold, and fair between,
> Hope's shifting light of emerald green,
> With either side, in deep relief,
> A crimson Pain, a violet Grief.
> Would'st thou, amid their gleaming hues,
> Clutch after those, and these refuse?
> Believe, as thy beseeching eyes
> Follow their lines, and sound the skies,
> There, where the fadeless glories shine,
> An unseen angel twists the twine;
> And be thou sure what tint soe'er
> The broken rays beneath may wear,
> It needs them all, that broad and white,
> God's love may weave the perfect light."

At a glance you perceive what an extended theme is offered for the limits of a lecture, and what suggestions naturally fill the mind of a thinking being. If the Almighty has created such realms of space, such systems of worlds, whole oceans of suns, and beyond these, nebulæ, which, in their hazy condition, as the spectroscope has demonstrated, are yet unformed worlds, how the mind is lost. And when we with wings of light, which are leaden in comparison with the wings of imagination, pass from universe to universe, until we sink exhausted—it is but the beginning of the end.

But I propose, instead of presenting this in its vast field and in its poetic relations—because there is poetry as well as solid facts in science—to come down to three simple points: 1st, How do we produce light? 2d, Of what is light constituted? and 3d, How do we measure it?

We produce light first, by the production of heat. Before you is a

very simple gas burner, known under the name of the Bunsen burner. The ordinary street gas is here consumed, and heat is the result. If I close the lateral apertures (illustrating) light is the consequence. How do I change heat into light? I must first have chemical action; and such was the result of the union of the primordial elements. They combined, and light was the consequence. And it requires a certain adroit arrangement of those elements in order that we may produce it. By shutting off the access of air below, the flame of the Bunsen burner becomes luminous. The same materials are burned, but they are burned in a different way. Here is a jar containing a gas known as chlorine. I excite chemical action with powered antimony, and produce light. A solid body is here heated to develop chemical action, and you see the result. In another jar of the same substance I place phosphorus, and it burns without light; but, bringing it into the open air, it produces a brilliant light. In this very flame I will sprinkle these little particles of iron, a solid body, and you remark that instead of simply heat, light is the result. In order to produce light, we must first evolve heat; and this we may accomplish by many means. We may accomplish it by the union of such elements as oxygen or chlorine; with a solid body, or with gas. Here is a bit of phosphorus. I place upon it some particles of iodine, and speedy ignition results, with a beautiful purple flame. Two solid bodies may combine, and we may have light as a consequence. In lieu of this, we may employ even ice. I place upon this piece of ice a little potassium, and it ignites and is even explosive. We have here a jar containing oxygen gas, and if we place in this some body which is capable of forming a solid residuum, we shall obtain a light. There are some fragments of zinc, which, being heated and dipped in the oxygen gas, produce a brilliant light and a white substance known as the philosopher's wool. h ere we have a solid body rendered incandescent. If, in lieu of zinc, we take another solid, magnesium, it will give off white fumes, and produce a brilliant light. To produce light, we must not only accomplish the production of heat, but must have a solid body glowing at an incandescent point. To demonstrate this in a different form: Here we have a reservoir of oxygen, and another of street gas. If we were to use pure hydrogen it would be still better. By turning on the gases, they produce an intense amount of heat; but if we dd a solid body, as the particles of iron which have been placed in a cavity in this brick, when they begin to glow they will produce a

brilliant combustion. We can produce an intense degree of heat by oxygen and hydrogen combined, and a solid body placed in the flame will glow with a certain degree of intensity. This is accomplished in the ordinary way by the use of lime or by the employment of magnesia, mica, platinum, or any substance that can be made incandescent; and thus we may get one of the most brilliant lights of the present day. Here we have some compressed magnesia, and here are four little jets of oxygen and carbureted hydrogen, and you see that they produce a brilliant light. This is the form of light with which you are familiar under the name of the Drummond light, although the name which properly belongs to it is the Hare light, for it was Prof. Hare, of Philadelphia, who first showed that by the union of the two gases, oxygen and hydrogen in exactly the proportions found in water, two volumes of hydrogen and one of oxygen, we may produce this intense degree of light. You now see [returning to the brick thoroughly heated in the flame] that the iron becomes warm—the iron boils, the iron burns—and it gives us this generous illumination. If we were to catch the little particles which shower in every direction, they are particles of oxide of iron which are thus produced; and by increasing the force of the jets of gas we might increase this shower of sparks until it rose to the ceiling. This teaches us that we are not only to consider intensity of light, but also the volume of the light which we are to produce. You see here the triumph of the discoveries of Sir Humphrey Davy, who said that the crust of the earth was a mass of oxydized metals, that at one time glowed with fervent heat; that it was then a sun in glory, although now a world higher in dignity than if merely an empty sphere emitting a fierce light associated with chemical heat. We have here two compressed gases, as before, oxygen in the one and carbureted hydrogen in the other receiver. You perceive that as we allow the two to be discharged in jets of burning gas, we have very little light; but placing a pencil of compressed magnesia in the flame, it produces a light pleasing to behold, and one of the modern triumphs of science. In the one case we have heat, and in the other light. It is by the adroit arrangement of these burners that we produce this effect; and it requires a nice adjustment of the two gases to evolve the most intense light.

Let me now ask you to observe what takes place when we employ a simple candle flame. We have first the particles of hydrogen that burn and form water; and then we have the minute atoms of carbon

burning in the flame, which give us this characteristic light as well as heat. Below we have a bluish tinge and above we have the red, and intermediate the yellow; and thus we have the same series of rays that we find in the solar spectrum. This has been taken as the type of all forms of light. Suppose that we had only the ordinary street gas, and some one should come forward and claim that he could condense the gas into a solid form, cleanly, white, compact, which you could even carry in your pocket or in a trunk without injury, and yet you could apply to it a match and evolve from it gas, and could burn it so as to furnish an ordinary light, what a triumph the candle would be over modern chemists. The flame of the candle well illustrates the physiological phenomena constantly occurring in our own bodies. We live in oxygen gas, and are converted into the carbonic acid and vapor of water into which this candle passes. Sad to say, while we are bright and luminous without, we are too often dark within.

From the candle we may pass to the variety of light which we may obtain from different liquids of the earth. You all know that we may obtain oils from the animal world, and from the plants; and from the animals that inhabit the sea as well as those that dwell on the surface of the earth. But let us remember that all of these substances have derived their life from the sunbeam; and hence the light we get has been derived from that source. Let us go even to that oil which bubbles up so generously in our own soil, and has been found in other lands, the rock oil, or petroleum; so that we not only have a land "flowing with milk and honey," but we have the richness and fatness of the earth pouring forth, and which has been such a source of pleasure and profit in our own time. These oils are derived from that extraordinary source, the coal. Familiar as the facts are to all of us, that the coal is the stored-up residue of the ancient life that once decorated our planet, we may not always remember how entirely different that was from the vegetable life we now find about us. The earth was not then a planet fitted for us to live upon. There was not a plant fitted for the humblest of our animals. There were none of the fruit-bearing trees; none of the classes which give to us the peach, the apple, the glowing pomegranate, the gorgeous orange, and the like; not one of the cereal grains, the wheat, the rye, the oats, the barley; none of the sweet-smelling herbs; none of the flowering plants; at the same time there was none of the varied and beauteous forms of insect life which lived upon the flower; but

there was only the simple coarse form of vegetation represented by the fern of our day. This is buried up amid strata, oftentimes containing only the faintest indications of their origin; and yet cut into thin slices, it tells us by its cellular structure that it came from the plant-world. The hard coal that we burn, under the microscope, reveals the same facts; sometimes a leaf or a branch, occasionally a whole tree, at other times rootlets are revealed; and thus we learn of the variety of plants from which we have stored up for us that element which is to us a source of heat and a source of light. I never can think of this without reflecting upon the little seedlet. Cut an almond in two, and we find a germ, and around it the starchy granules which are to be the nutriment for it in its early development. In its babyhood it is to be nourished by that which is stored around its most vital part. So God Almighty has arranged our earth and fitted it for us; fitted it for the great functions of our race, and stored up that which give not only heat and light, but power. When we reflect that every pound of coal that is burned in a minute of time represents 300 horse-power; and according to the estimate of Tyndall, the amount of coal consumed by England alone represents the power of 800,000,000 horses, we get some idea of the ancient forces that played upon this earth, and that have been stored away for man's benefit.

You are all familiar with the operation of burning coal, so that I need not dwell upon the changes which heat effects in it. Here is a little specimen which was obtained from a vein a mile and a half within the earth, and which now bears the marks of the bark of the tree to which it belonged. Let us subject this coal to heat. Placing it in the bowl of a tobacco-pipe, it gives off oils and gases; and after it is heated the gas creeping from the stem of the pipe may be lighted, the coal giving us both heat and light.

If you will look at this chart, it will help you to understand how this gas is made. Here is a retort of iron, and here is a furnace. When this retort is filled with coal, gases are evolved which rise in this metal tube. Next to this another set of furnaces is placed, back to back, on the same principle that two in a bed are warmer than one. The gases and the vapor are partially condensed, and passed into the hydraulic main, as it is termed, and then the gases descend and ascend through these tubes, or coolers, which reduces the temperature of the gas. Then we have here a shower of water which passes through the gas and washes out the impurities, and at the

same time cools the gas. To insure success a second arrangement of this kind is adjusted, and the rain descends and the impurities flow into the reservoir below. Then we have instruments which relieve the retorts from pressure, and there is a beautiful mechanism by which the gas is passed under water, and valves are so arranged that the water may be changed but the gas will not escape. Here we have the method of purifying it, with a series plates of lime. The gas is then received into the large meter, where the amount is determined, and then into the grand reservoir. When I tell you that a single company in the city of New York makes 4,000,000 cubic feet of gas every twenty-four hours, you will have some conception of the magnitude of the scale on which this operation is conducted. From this it passes through a regulator or governor, and is distributed through the city. I have not time to enter into all the details; but this is the beautiful mechanism by which is generated the gas which we constantly employ. Lest I should be inaccurate, I called, the other day, upon the Manhattan Gas Company, and they stated that they made, last year, 1,250,000,000 cubic feet of gas. The other companies—the New York, the Metropolitan, and the Harlem Company, associated with it—produced about 2,700,000,000 cubic feet of gas the last year. If we estimate this at the price of the gas of the Manhattan Company, which is three dollars per 1,000 feet, this amounts to nearly $8,250,000. If we consider that about 20 per cent is lost by leakage and in other ways, we have at least $6,500,000 expended in the production of gas for illuminating purposes; and this in one city! We can hardly fail to be reminded of that astounding proposition of our great philosopher, Franklin, who proposed to save England millions of dollars annually, in this way: "Let people go to bed half an hour after sunset, and rise half an hour before sunrise." Let us not forget that in the great coal strata we have stored up the forces of the light which originally shone upon the earth. It may have been light which surrounded or invested our globe, or that received from afar.

We can produce light by chemical means, far surpassing anything which I have yet shown to you. It is simply by the galvanic battery. You are all familiar with the fact that by putting acids and metals together, or any substances that have a chemical affinity, we have certain powers revealed. Here is a cell of the form which we shall use this evening; a glass jar containing about 1⅓ gallons of water, with a zinc cylinder, and a porous cup, and slab of carbon. Within

the porous cup containing the slab of carbon, we place a solution of bichromate of potash, and upon the outside, in the outer jar, we pour diluted sulphuric acid. We have here a battery of 250 of these jars, which the gentlemen who have kindly assisted me in preparing for this lecture, put together between 10 and 2 o'clock last night. By bringing together the copper wires so as to complete the circuit, we obtain what is called the electric light. It is a small point, but intensely hot; and the light increases in brilliancy as the metal is consumed and the distance between the points is increased. Substituting for this point of copper, one of a mixture of copper and zinc, we have a light giving us white fumes from the zinc, and a greenish tinge from the copper.

Next I take a point of iron, which produces a brilliant light; and, as you see, as the iron is consumed the arc increases until at last the distance between the points is so great that the electricity cannot bridge the space. [The dazzling light, when that distance was reached, suddenly ceased.] Now, employing a pencil of carbon, we shall have a still more intense light, this being that which is known to us now as the galvanic light. By separating the poles we break the current of electricity, and thus the light is lost. In order that you may fairly judge of these different degrees of light, let me bring before you the means by which we measure the intensity of light—the instrument which is the subject of our lecture—the photometer, or light-measurer. We may compare lights in two or three different ways. We have several forms of photometers. Thus we sometimes measure the light of the sun by the thermometer, by measuring the amount of heat set free from that magnificent orb. We learn from the latest investigations the fact that our earth receives only a very small part of the light and warmth emanating from the sun, which is itself so large that were it hollow, and the earth placed in its center, there would be almost room enough for another moon outside our satellite, within the surface. The sun sets free as much heat as would be produced by burning no less than seventeen miles in thickness of coal covering its whole surface, within a single year. But our earth receives a very small portion of this heat and light. Conceive a great concave sphere, with the sun in its center, and the orbit of our earth in its circumference, and you will see what an infinitesimal portion of the surface of that sphere would be occupied by our earth.

We thus learn that our globe receives but one 2,300,000,000th part of the heat set free from the sun. Another method is by measuring

the chemical beams of the sun in their photographic power. Many years ago, Prof. J. W. Draper suggested a simple instrument containing a mixture of hydrogen and chlorine gases, which by their gradual combination should test the actinic force of a beam of light. Another method is the direct measure of the illuminating power. The most simple way to test this is by comparing shadows cast upon a screen; and for this purpose we will now darken the room, and you will observe, first, the shadow cast by a metallic rod upon this screen, when we have only the illumination of a candle flame. Now, lighting this gas-burner, giving a flame from the ordinary street gas, you observe that the shadow of the bar from the candle has become invisible, or can hardly be seen, and the shadow from the gas alone appears upon the screen. Let us now allow the oxygen jet play upon a piece of compressed magnesia. We have a still more brilliant light, which grows brighter until not only the shadow of the brazen bar from the candle but that from the gas disappear. I now burn a strip of *metallic* magnesium which overpowers by its brightness the other lights. Next we come to the galvanic light; and now you see that the magnesia shadow, as I move it, is itself very faint, although the galvanic light is at a greater distance. You see how the galvanic light overshadows all the others. It is the brightest of all known lights. Now, lowering these lights, I will introduce, while the room is still darkened, another experiment—the production of the electric light. All are familiar with the fact that the electric spark can be excited by friction upon dry, warm, brown paper, glass, vulcanized india-rubber, or gutta-percha.

When we pass this current through a vacuum, we have not pure white light, but a series of colored lights, very much such as we witness in the higher part of our atmosphere in the winter season, especially in the arctic regions, and which we know under the title of the aurora borealis. We can imitate this by a small electric machine. To obtain an imitation of the peculiar light, we will pass the current through a series of tubes, about twelve feet in length, and filled with different gasses. When these tubes are revolved with sufficient rapidity, it produces the effect the pyrotechnist sometimes exhibits, of wheels apparently rotating in the air. Before lighting up the room, I will show you an experiment to demonstrate how harmoniously colors are blended. In these plates before me [extending entirely across the platform in large numbers] we have prepared a light diet of salt moistened with alcohols. Setting fire to this it

will burn with a peculiar light, containing but one color, which we therefore call a monochromatic light. Now that they have been lighted, I ask you to mark its effect upon these silken flags of various colors. In this flame there is no red light, and the consequence is that all these colors are lost excepting a yellowish tinge. The red has departed from our lips, and the consequence is that we present a ghastly, cadaverous appearance. Don't look at *me*, please look at each other. As this gradually dies away, let me call your attention to another triumph of modern science in regard to electricity as a means of producing light. At the capitol at Washington, if a committee is engaged in a private conference when the sun is setting, and they wish to continue in session, the gas is turned on and in an instant, by electricity, the room is lighted. So here, a spark lights the gas, and thus we receive the light which changes the hues of our faces and of all these pieces of silk to their natural colors. [The sudden lighting of two chandeliers at the top of the room by electricity was received with applause. The gas was again turned off, and relighted in an instant by the same means.]

Let me now take the liberty of presenting to you one of the most beautiful applications of modern science to the production of light. About three years since, M. Tessie du Motay, a French chemist, of great distinction and originality, conceived the possibility of producing oxygen by decomposing the alkaline manganates, with superheated steam. M. Schwartzwehee, Professor of Chemistry at Metz, was requested to test the truth of his conception. This he did, and found to his delight that manganate of soda was decomposed in the presence of superheated steam. Perhaps it would be a violation of confidence if I were to tell you how these French gentlemen expressed their delight at such a discovery. The result was the erection of works on a grand scale at four different places, each successively triumphant, a fifth near Paris, and the sixth will be in the city of New York, where oxygen will be made at such a rate that it can be disposed of not only for theoretical purposes, but to be employed in practical use. Messrs. Ball & Black have adjusted these two candelabras for the oxygen and hydrogen light. Here we have nine covered jets, by the side of twenty-five jets of common gas, and on the opposite side of the platform you have nine uncovered jets by the side of twenty-five uncovered lights. You can judge of the brilliancy by comparing them. [The new lights filled the hall with a light resembling noonday, and by their side the gas flames appeared pale and

yellow.] The limits of a lecture will not permit me now to explain the advantages of this light. One of these is that, as the light is derived from an incandescent solid body, and not from a mere flame of gas, there is no flickering, but a constant and steady light. By this light, too, you see that hues are happily blended better than by candle, oil or gas-light. Further, it is demonstrable that a six-foot gas-burner sets free as much impurity as eight or nine persons sitting quietly here. When you remember with what fatal effects, in the Black Hole in Calcutta, 140 persons were imprisoned in a cube of eighteen feet, with two windows, most of them dying before the next morning, you will see the importance of substituting for a burner setting free as much impurity as eight or nine persons, one which furnishes its own supply of oxygen and greatly diminishes the carbonic acid. We have here a white and steady light, so brilliant that you need to protect your eyes, and yet filling the room with such an illumination that a gentleman who usually finds his sight too short for reading in the evening, assures me that he finds this to take the place of his failing eyesight. Here we have, from the same amount of gas, sixteen times the supply of light, and instead of robbing the air, it provides its own supply of oxygen. According to the experiments made in Paris recently, under the order of the Emperor, the saving in expense is thirty or forty per cent. I have not of the other properties of the light, further time to speak than to say that the photographer can employ it instead of the light of the sun. A year ago the City Hall at Paris was lighted up as you see this [with oxygen], and now the Tuileries are lighted in the same manner. For nine years an electric light has been shining from the chalk-cliffs of England, and two electric lights shine from the port of Havre; why should the grandest city this side of God's globe, be satisfied with an oil light? A French steamer visiting our shores months ago succeeded in finding mechanism with gearing capable of giving 2,500 revolutions; and she came in with the sunlight streaming from her bows, the tax upon her valuable property being one per cent less as a consequence. And night after night, from her dock, did she shoot her beams across to the Jersey shore in demonstration of the value of this light. A steamer, amid the movements of the ocean, could produce this splendid light, with a loss of less than two horse power. I was told, by one of the Board, that the galvanic battery was expensive. Only a day or two since it was stated to me that a bark came from Malaga freighted with fruit, expecting to arrive here for the holidays.

For ten days or two weeks she was near our shore, failing to see our light; and when she arrived, the spoiling of the fruit, and the loss of the market had occasioned a loss of $15,000. This is but a homœpathic illustration. What would be the value of the light to a magnificent steamer, worth half or three-quarters of a million, with freight worth a million of dollars, to say nothing of the valuable lives on board? Had the ill-fated Arctic possessed such a light, would she have been stabbed between wind and water as she was, and her cargo not alone, but precious lives, lost? Again, I am told that the galvanic battery is difficult to keep in order. Do we know it to be a fact that we can send a telegram from here to Boston, to Philadelphia, California, or to the other side of the ocean? Do we not know that thousands of galvanic batteries are kept in order night and day? And are we to have our coast guarded only by oil lights? When I spoke to the president of the Chamber of Commerce about this a year ago, he said, "We know nothing of the matter; we are not familiar with these chemical themes; and we leave it to this illustrious scientific board." It is to be regretted that after all the discoveries made within the past few years, we have not science applied on the coast of America as it is applied on the coast of Europe. [Applause.] I will now show you one or two experiments to show the power of this electric light. You will readily believe that my able assistant, Dr. Wilkinson, experimenting with the galvanic light was so overwhelmed by it that he had to shut himself up in a dark room for forty-eight hours, unable to bear even a candle light. Passing a spark under water, you see that we have light under most unfavorable circumstances. And here you find that we can produce it even in a vacuum. It is the nearest approximation to sunlight known to us. It is due to the union of certain elements. The basis of all light is oxydation, and we know that ever since the Almighty breathed upon man the breath of life it has also been the basis of our life.

I regret that the time is so short that I cannot exhibit to you all the phenomena I desired to show, as, for instance, relative to the employment of refractors of light and reflectors of light. We have here a reflector having that peculiar curve denominated a parabola, which, when perfectly made, has the power of reflecting beams of light in a parallel direction. The same may be accomplished by the beautiful lenses devised by the French investigator, Fresnel. It is highly important in lighting the coast that, instead of the light being radiated above and below in every direction, the rays shall be sent in

a parallel line so as to produce a more brilliant light. Observe the tints of the silk of these flags as I hold them before this reflector. Let me now ask your attention for a moment to the instrument commonly employed in photometric investigations. It was invented by Prof. Bunsen of Heidelberg, to whom we are indebted for other most beautiful physical and chemical discoveries. This is a beautiful application of the law that light is in inverse proportion of the square of the distance. Here we have a small bit of paper, which, when you view it by reflected light, shows a central disk which is white. Viewing it by transmitted light, the central disk is black, the paper being greased upon the circumferences, rendering it semi-transparent, excepting this central spot. This instrument is placed in a room perfectly dark, the walls, ceiling, and floor being blackened. There is a graduated scale, on which this disk is placed. At one extremity of the scale is placed a standard candle; and at the other end the candle or other light which we wish to measure. This disk slides easily back and forth, and is so adjusted that the light upon the two sides shall be of equal intensity, so that the central spot is almost invisible. If either appears brighter, we slide the disk toward the feebler light until they agree. Then if we find that the distance of the candle from the disk is five times as great as of a gas-light, we must square this number, producing twenty-five, and it will show the brilliancy of the gas-light to be twenty-five times as great when compared with this standard candle. If the distance is only four times as great, the square of four being sixteen, we know that the gas-light is sixteen times as brilliant. Ordinarily, if gas be burned in a circular Argand burner, possessing fifteen apertures, and having a glass seven inches in height, burning five cubic feet per hour, under a pressure of half an inch, its light will be equal to sixteen candles. In some cities, as in Baltimore, and I was told to-day, by Prof. Silliman, in Chicago, they publish every week the illuminating power of the gas produced in those cities, so that the public have a check upon the gas companies. I ought to say of the Argand burner, that the amount of light depends partly upon its form, whether the orifices are larger or smaller, whether the chimney is higher or lower, &c.; and all these circumstances must be taken into consideration. But we know that candles differ. The standard is that it must burn two grains per minute. The candle is lighted, and when it is fairly burning, we counterbalance it with little weights; and thus we can easily ascertain the amount of material consumed in

a given time, say half an hour, or an hour; and we can compare that with the standard. There may be a variation in the wick; and furthermore we have not the standard of volume; and hence our measures of light by no means compare with our measures of heat. We place our thermometer in boiling water and melting ice, and obtain our standard points from which to measure; but we have no such standard with regard to light. Yet there is enough known to guide us to a certain extent as to the volume and intensity of light, as well as its healthfulness. The brightest light man has ever made is the electric light, the brilliancy depending upon the magnitude of the battery we employ and the activity of the oxydizing agents. Next the magnesium light; then we have the Hare light, modified by applying in the flame platinum or compressed magnesia. The preparation of oxygen gas at a commercial price is the great discovery of this century, and which I hope before many months will be introduced into practical use in this city, for there are competent men who have taken hold of the problem with the intention of solving it here as it has been solved abroad, and we shall have a light cheaper and more wholesome. In this connection let me say that light should come from above, for God Almighty has so arranged it. He has given us eyebrows and eyelashes. The light should be near the ceiling, that it may be transmitted from above, and that the impurities from the gas may be carried out. You know I am not addressing the audience I addressed an hour ago. Particles which formed your bodies then have gone democratically into this atmosphere, to be remodeled into other forms and figures; and particles of food of which you partook to-day are now being transmuted into your living selves. We are like the candle flame, ever changing. We have the semblance of identity; but new particles continually enter into our composition, giving us genial warmth and intellectual light. One of the grandest features connected with humanity is his ability to produce and evolve these imponderable agencies, heat and light. It is a God-like attribute, and one of the most important, not only to the health of the body, but the wealth of the pocket.

I have endeavored in this short time to touch upon the salient points in this extensive field of investigation. I will now ask your patience for a moment, while I allude to a beautiful theory, sustained by some electrical experiments, showing the relation between undulations of light and of the atmosphere. If I pass a ray of light

through a prism, as you will see in a future lecture, the colors of the rainbow will be produced; the red, the yellow, and the blue. The red ray corresponds to the lowest note of the gamut, the base or fundamental note; and, passing through those other colors, we reach the higher notes. The undulations of sound are few. We know that thirty-two to the second can be appreciated by an ordinary ear, and some claim that they can appreciate sixteen vibrations; from this we ascend to 30,000 or 40,000 per second. But, with regard to light, we pass to a degree of refinement far surpassing that of sound; for it is claimed, as the result of investigation of the undulatory theory, that the red ray will perform 40,000 undulations in a single inch. Light moves at the speed of 200,000 miles per second. There are about 5,000 feet in a mile; so that we have 1,000,000,000 feet, or 12,000,000,000 inches. Multiplying this by 40,000, we have the enormous sum of 480,000,000,000,000 wavelets that break upon the shore of the retina of the eye in a single second, while we gaze upon a distant red star. This sum is too enormous to be appreciated. Divide the little arc through which the pendulum swings in a second into 1,000,000 parts; and while the pendulum drops through one-millionth part of its arc, the red waves strike upon the retina of the eye 480,000,000 times. To count a million of millions requires 30,000 years, if we count one each second. What shall we say of 480,000,000,000? Think of the antiquity of our race, 6,000 or 8,000 years, as compared with this astounding number; and if we pass to the higher undulations, how vastly they must exceed it. We have a harmony in light, as we have a harmony in sound. When we think of this, as we move off in imagination to some distant star, or to some nebula, sending its light to us millions of ages ago, the mind is overwhelmed with the thought: Truly, whatever man may be morally, intellectually he is "little lower than the angels."

SCIENTIFIC LECTURE—X.

ON COMPARATIVE ZOOLOGY.

By Mr. B. Waterhouse Hawkins.

The tenth lecture of the scientific course, before the American Institute, was delivered last evening, January 27th, 1869, by Mr. Waterhouse Hawkins, of London, at Steinway Hall. Judge Daly, vice-president, having introduced the lecturer, Mr. Hawkins said:

Ladies and Gentlemen: My object to-night in speaking of the subject of comparative Zoology is to place before you a comparative view of reptiles and birds. I am aware of the difficulty I have to contend with in making comparisons. Among our many household proverbs, more or less true, it is said "The value of all things is comparative," and again, that "comparisons are odious," Mrs. Malaprop's version of which is well known. At the same time I can only suppose it possible for us to arrive at a just conclusion in questions of natural history by comparing one form with another. There is a disadvantage in comparing reptiles, which have the misfortune to have a bad name —with birds, which every one admires. Reptiles are crawling, creeping things. The record of their creation takes a very early place in the history of the creation. They are cold-blooded, slow, and at the same time scaly. They are altogether disagreeable; and there is also a saying that there is a kind of enmity or unpleasant feeling between man and these same scaly individuals. Birds, on the contrary, are almost celestial. If we do but remember the lark, "that upward soars and at heaven's gate sings," as the poet tells us; if we think of the "charms of nature's jewelry," as the humming-birds are called; and especially if we think of those other creatures with wings, which we may reasonably suppose borrowed them of the birds, no! that could not be, for the angels are believed to have been created first; but it is evident that the birds can use their wings better than any imaginary figure of an angel could, we may readily suppose that the

birds had an advantage in the earliest periods of time. With regard to this poetical idea of the power of flight, a creature having wings being always a favorite object for comparisons, allegories, &c. I must say in defense of the class of creatures with which I wish now to compare the birds, that they are also mentioned among the fowls of the air as flying above the earth; and the record of their existence refers not to birds exclusively, but has direct reference to flying reptiles. If, then, I can prove to you that reptiles could fly, without which the comparison would be incomplete, you will see that the comparison between reptiles and birds is not so impossible as it might at first sight and sound appear to be. There is an advantage in comparing two things that are supposed to be so dissimilar as reptiles and birds, that we shall thereby more plainly see that grand unity of plan, that sublime oneness that pervades all animate nature. Every living thing with which we are familiar is constructed, and designed upon that one plan, which is godlike. So far is this of advantage to the observer of natural history, that I am convinced it is the only channel by which observations upon nature can by any possibility lead up from the things created to the creative power. If we do not appreciate that one distinctive feature, the oneness of the plan, and the variety contained in that oneness, it is impossible to have the same grand feeling of worship for the powers of creation.

I will then endeavor to show you the machinery of life; the life-machinery of the reptiles and the birds; my object being to convince you of that unity to which I have just alluded. The frame-work by which we compare one creature with another is designed for a specific purpose; that purpose being to contain and to protect the vital organs; it is therefore secondary in character to the vital organs, which it is designed to protect. I will endeavor, in the first instance, to represent to you the vital organs of a reptile, and the same of a bird, for the purpose of bringing before you an intermediate form. It has been said by naturalists, Mr. Darwin among the number, that the geological record, containing the remains of the forms of life that are called extinct, is so imperfect that we have no direct evidence of an intermediate form. It is extraordinary that he, of all other persons, should make such an assertion. Intermediate forms are numerous. But I beg to observe that their recognition is very dependent on our degree of faith in the persistence of species. If there be intermediate forms, and particularly in relation to those forms that have passed away, you will at once perceive my object in placing before

you animals as they are now constructed, in conformity with the maxim of one of the greatest philosophers who has written in the English language, that "it is necessary to know the things that are present with us, to have anything like an acquaintance with the things that are past. Without detaining you further, then, I will endeavor to give you first, the construction of the reptile, then of the bird, and finally to exhibit to you the intermediate form of which I have a gigantic specimen here, which, through the kindness of the commissioners of the Central park, I have been allowed to bring before you, prematurely, because they were unwilling that the illustration should be wanting, and which is, in fact, the first installment of the works I have the pleasure of executing for that institution. In the first place, I would remind you that it is absolutely essential for every living creature to have the means of feeding, and depositing that food in such a situation that it may bear the same reference to the living body as the fuel bears to the locomotive engine. We have, then, here that essential portion. [Mr. H. here commenced to draw a reptile on the blackboard, describing the details as he proceeded.] I have some hesitation in introducing so unpoetic a portion of my subject at the commencement; but it is followed by the next organ, which is one that the poets have thought proper to immortalize, while they have said nothing of the existence of this stomach, they are all agreed that there should be a heart. I am reversing, of course, the grandeur of the poetical idea, when I say, no stomach, no heart. We often speak of a "hearty" meal, though I am afraid that would not quite justify me in putting the heart subsidiary to the stomach. As I have compared the sack receiving the food to the furnace receiving the fuel, you will forgive me if I speak of the heart as the force-pump that distributes the material to restore and revivify and reconstruct every part of the creature's body, renewing its strength day by day and hour by hour. These are two essential functions. The third is that which can supply the necessary air to that vital fluid, rendering it thereby capable of doing its work, consisting of a series of tubes or pipes, large trunks and small branches, distributed over chamber or cells of tissue, and called the lungs; by means of which, those blood vessels receive the action of the oxygen of the air, so arranged as to occupy the least possible cubic space, and yet covering the largest possible amount of surface, thereby showing the intention and the perfection of the design of that function, as we find it throughout the whole animal creation. The oxygen reaches

those cells or chambers through a tube at the back of the mouth. Together with these three functions, essential as they are, we have another one, which must be present to provide for the possibility of the creature making the other parts of his body subservient to his requirements; in short, to put him in communication with the outer world. We find, then, an agglomeration of peculiar cells and fibers, constituting the brain, in one place, and attached to it a cord, which I always feel disposed to compare with the electric telegraph, passing through the whole length of the body from one end to the other. These soft organisms are protected by a harder framework, as it were to house them and keep them from all danger. The most important of them, and the best protected, is that same electric telegraph. This framework is from a simple design; a simple piece of bone. It is one of the features of nature that every portion of it is but a repetition of a similar design. There is a bone, with an arch above to inclose the spinal column, and protect it from injury, and below an arch to contain the other vital organs. Please to remember that the soft parts are first in existence, and that hard parts are only formed and molded upon these soft parts; and then you can at once appreciate the fact that these hard parts, being secondary to the vital parts are made expressly for them, and correspond to their exact situation in the body; and, consequently, knowing the relationship of these more permanent parts to the vital organs, the interpretation of fossil remains is no longer a mystery, but a simple faculty that every child may acquire. In connection with this electric telegraph, communicating with the main battery, we find from one end of the creature's body to the other, sentries for its defense, putting him in communication with the outer world. Here are placed a pair of eyes, which enables him to see distant objects. Immediately behind these are the organs of hearing, protected by a very hard piece of bone, to enable him to hear that which he cannot see; and lest these should fail, there is a third, the olfactory organ, containing, spread out within, a beautiful reticulation of a portion of nervous matter, which enables him to smell that which he can neither see nor hear; that he may know when to advance if the object be useful to him, or to retreat if it be the reverse. With all this, he is in a condition to live, but not in a condition to move. The soft parts are protected by the repetition of this piece of bone, the vertebra, one after another, united more or less by an elastic material, so as to give the creature facility of movement in one or the other direction, as may be essential. Thus these

animals inhabiting the sea have the upper and lower portions of these bones drawn together, so that the animal can move laterally with the greatest facility, but not so easily vertically; while the creatures occupying the land have the arrangement the reverse of this, the sides being more closely drawn together, so that they can move more easily vertically and not so easily laterally. Then here we have the bones or spines, more or less elongated, according as the weight of the outer coating may require. In the case of a reptile that is heavily coated with armor, we find these spines very strong, and with a kind of flat form on the summit, which will bear the outer scale or plate, which is to act as defensive armor, serving to protect the vital organs within, yet not so important or so complete a protection as the bony parts themselves. We have now to add to the head, the lower jaw, and the teeth of the upper and lower jaw, the length of one giving us the length of the other; for I have often been obliged to be contented with a very small fragment of either or of each, as I shall presently show you. We have now to add the limbs upon which all this is to be supported, and which give facility of movement. We find here in front a portion of flattened bone, which will hold this limb, so that it can move freely, then, this second bone, coming from the shoulder. Then we have two bones below; I mean the reptile has, and so have we [laughter]; and then other bones corresponding to our hand, and there are five digits or fingers. Then we have here the pelvic arch, represented by the extension of these pieces of bone, and then we have the bones of the leg, the two bones coming to the heel and ankle, for the reptile has an ankle, although it may not be as pretty as some other ankles [laughter]; and then we have here four toes, terminated with claws, more or less elongated, corresponding with the terminations upon other feet, whether claws, or hoofs, or nails. This creature has a very long tail, with spines above protecting the spinal cord, and with projections below the tail, shaped like the letter V, for the special protection of the large blood-vessel necessary to give force to this organ, which is its instrument of defense. These bones, shaped like the letter V, are more or less elongated, as the creature may have more or less occasion to press the tail upon the ground. I trouble you with this detail simply to prepare you for the large animal that I have here, which is organized and constructed in precisely that manner; and I want to show you that we can trace the habits of the animal from these bones which form a part of his tail.

Now, suppose this to be surrounded by a framework of muscles; and I assure you that a crocodile can be both muscular and very fat, for we had an incident the other day in reference to an alligator in the Central park, which was in very good condition; and having been wounded previous to his arrival, it left an awkward orifice in his side, of which, when he became torpid, the mice and rats, in a very unfair manner, took advantage, and positively made an entry, a circumstance which did not agree with his ideas of vitality, and consequently he gave us the advantage of a dissection, in which we found both muscles and fat upon this framework, and I hope he will contribute also to the museum which the commissioners are now forming of natural history, for the instruction and pleasure of the frequenters of Central park. Outside of this muscular portion, arranged over the bones, there is a species of scaly armor on the upper ribs; each plate or hard piece of bone, like the scales of a fish, is arranged with a joint between each of these scales and those adjoining, and thus the creature is defended by a most powerful armor, and yet not impeded in its locomotion by being so thoroughly defended. [At this point the completion of the drawing of the reptile, beautifully executed with chalk of different colors, was received with applause.] So much for the reptile. I will now repeat the same thing with reference to the bird. [Mr. H. proceeded, on another blackboard, to draw, as before, the structure of a bird.] We have here the same arrangement again. We have the commencement of the stomach and its first orifice. A bird has a complicated stomach, very like that of the ruminating animals. The next organ is the heart, which everybody will suppose is more poetically related to the bird than to the alligator; but it is not so. He has four chambers, it is true; but all the rest of the machinery is the same, and for the same purposes. Next we have the breathing apparatus, or lungs, which, in the case of birds, is placed portionally. Bone for bone, the bird will bear comparison with the reptile; for although some of them may vary in size and form, the arrangement is the same. Here are the projecting face and jaws, having the same relation and general form as in the reptile. Next we cover this with muscles, in the manner that my outline indicates, giving the bird a grotesque appearance. You remember the story of the philosopher throwing into the midst of Plato's pupils a bird plucked of its feathers, which he said came within his definition of a man, because it was "a two legged creature without feathers." As this bird, being without feathers, is somewhat shorn of its beauty, you will

allow me now to indicate to you the situation of these integuments, first calling to your attention that the arrangement I have shown you is the same as in the reptile I have already shown. Whether these toes be united or spread apart for more convenient grasping, or whether there are three, four, or five toes, does not alter their nature, or the intention or design, but is a mere adaptation to varied circumstances, while the unity of the plan is apparent throughout the whole. Suppose these lines to indicate the situation of the feathers, the wings being the first important portion, here we have the feathers that proceed from the representatives of the fingers, called the bastard wings, a secondary wing, of no great use in flying, but useful rather in strengthening and supporting the other feathers. The long feathers which are used in flight are attached to the bones of the fingers, and are numerous and strong corresponding to the weight of the creature, and the necessity of supporting him during his progress through the air. The tail is composed of feathers of the most powerful structure, to steer the creature, and also to support the hinder part of the body. By its expansion it serves a most important function in directing the progress of the bird. Again, the legs are covered with long feathers, changing their whole aspect, so that it is commonly supposed that the legs only commence with that portion covered with scales. All of these cover the exact structure of the bones, and cover the muscular arrangements made to move the bones. You perceive that the entire structure of the framework in both reptiles and birds is subsidiary to the functions and character of the creature. [The completion of the drawing of the bird, much resembling in its outline the reptile before drawn, was greeted with applause.]

I would now ask your attention to the fact I brought before you in the first instance—the intermediate form. We have here a bird belonging to the early history of the world, and supposed to be one of the extinct forms. [Referring to a large chart.] It is the Dinornis, found in New Zealand. A small fragment of the leg-bone of this bird was brought to the College of Surgeons in London, and shown to Prof. Owen, who, after consideration and examination, pronounced it to be a bone from a bird. At the time he was almost laughed at for supposing it possible that there could have lived a bird having such a leg; and there were various experiments made by sending him beef bones, and asking him what he thought of them; but the indications of the bird-like structure are so absolute and unmistakable that he never was taken in or caught by the beef bones that followed in

numerous succession. In the Dinornis, you perceive, there is little indication of a wing; yet it is a bird. Therefore, you will ask by what characteristic it was so strongly marked that Prof. Owen could confidently predicate of it that it was a bird. Suppose this to represent [drawing in illustration] the leg-bone of a mammal. We find that in the bones of birds the outer wall is compact, but that they are hollow, and the outer wall of bone is supported by a series of splinters of other bones like little supporting beams, that afford a free passage of air through the bone itself. The hollow condition of the bone is an adaptation to fit the creature for raising its body in the air, rendering the bone lighter with equal strength, and thus tending to qualify the bird to fly. The bones of the leg of the ostrich, which does not fly but which runs with great rapidity, are provided with similar cavities, admitting warm air within the bone. Therefore you at once see that in a piece of bone belonging to a bird, however large, there are cavities by which it can be discriminated. Again, by the absence of these indications, and by the existence of comparative solidity in the bones of reptiles, it is possible to discern the difference, although the external forms may be alike, and there may be no other difference than the internal structure. We find that those birds that can walk but have no power to fly, much more nearly associated with terrestial animals than those which are actually birds of flight. But I shall presently show you that there are reptiles that can fly, as there are birds that cannot fly. Yet the birds that run, the ostrich, &c., are distinctly birds, and the reptiles that fly are distinctly reptiles, fitted for the variety of their situations in the economy of nature. Every terrestial ally that comes between the two characters of the bird and the reptile, you will find to be intermediate in form, but the general arrangement is the same. One of these intermediate forms we have here. [The Hadrosaurus of Dr. Leidy, recently restored by Mr. H., modeled from the original, was here revealed, by removing the curtain before it.] Allow me to state to you that this is no fable. It is truly a reconstruction, because I had a few pieces from the original to commence with. In my early interviews with the commissioners, I was expected to reconstruct such giant forms as most of them had seen in England, at Sydenham; but I suggested that it would be more interesting and instructive if the earlier forms exhibited as restorations should be from the bones of fossils found here and belonging to the past history of this great continent. [Applause.] I immediately searched the museums of

Washington, New Brunswick, and Albany, and ultimately of Philadelphia, where I found that there were a series of bones, such as I desired. I found that they had rich treasures in fossils, though they were in dark cases, and not to be discerned or understood by the public. The members of the curators and trustees of the Academy at Philadelphia most cordially and liberally allowed me the full use of those fossils, in consideration, of course, that it was a national work in which I was engaged, and on behalf of the commissioners of the Central park of your city. I examined those treasures, and found them to consist of these large bones; the thigh bone, which is forty-one inches in length, and the tibia and the fibula, the two bones of the lower leg, and two bones of the foot, and a small piece of the pelvis, which was in several fragments. These dark castings were taken from the fossils. I received permission to make the molds and castings on condition of leaving the molds in possession of the academy. The commissioners very liberally consented to that arrangement; and as soon as I got all I could get from that source, I proposed to place the bones I have named, and which are here of a darker color, in their natural position with my models of the bones that were not there, and so erect the whole skeleton at my own expense for the academy of Philadelphia, in acknowledgment of the liberal treatment I had received from them in facilitating my work for the Central park. After some difficulties I succeeded in completing it on the 17th of November last, and I presented it to the trustees and curators, who gave me an agreeable recognition of the fact of my having rendered that which up to that time was hidden science, popular, for the benefit, I trust, of the people, and especially of the young folks rising up, who will ultimately be as familiar with the giants of those ancient times as we are with the cattle of our present period.

Now, I will ask you to remember what I said with reference to the tail of the crocodile. You will see that these suggestions are here actually realized. There is the arch inverted to protect the large blood-vessel, because that creature had to use the tail by pressing it upon the ground to help him in keeping that erect position. Had there not been such provision as that, the circulation of the blood would have been seriously impeded. Hence you see the wonderful adaptation of that one plan, shown in the bird, which has not, except in rare instances, a long tail formed of bones, and in this reptile which has. These long spines, which are in some degree like those

of the crocodile, give us in the tail alone of this animal a good representation of the backbone of the fish, where the bones subserve all the purposes of the protection of the vital organs. We are not to suppose that the creature is always in this attitude; but having front limbs it frequently uses them. I am speaking as though I had seen them and known them; and sometimes I believe I have lived somehow before the present period of time, for when I look at these animals I feel quite sure I have seen them before somewhere. Those front limbs brought down to the ground cause such a change of attitude, that it is my intention, in the group that I am about to produce for the Central park, to present the creatures in each attitude of which they are capable, that I may so thoroughly represent their appearance in their ancient life. You will see that the teeth are very small. The front limbs are but half the dimensions of the others. From the shoulder to the elbow it is but twenty and one-half inches, while the thigh bone, fron the hip to the knee, measures forty-one inches. The lower leg measures thirty-six inches, while the lower bone of the arm measures net fifteen inches. Allow me to confess my own personality and invention with regard to the head. I had but a small fragment of the upper jaw, and a very small portion of the lower jaw and eight teeth in their place from which I had to construct this whole head. All the rest I admit to be out of my own head. [Laughter.] But I found I had some recollections of former times, when I had seen some very near relations of this creature at Sydenham. There we had an entire lower jaw, showing that they had no cutting teeth in front, and it only became necessary that the upper jaw should fit the lower jaw in such a manner that the creature should be capable of shutting his mouth as well as opening it. I had a number of vertebræ, three or four, but I thought I could "guess" as you use the word here, what the others were. Of the ribs I had small fragments, but enough to show what the rest were. The spines were broken away, but there was nevertheless sufficient evidence what the original parts were and to enable me to know their exact relations. The blade-bone again was an invention, but all the important portion which joins the head to the shoulder-bone, and that I discovered in a lot of debris which were supposed to be of no value, but which, to me, were invaluable to give the hollow piece which joins on the top of the shoulder, the glenoid cavity, and the piece in front of it, which explains its position and size. The hands I had to invent; but of the foot I was so fortunate as to have two of

the bones belonging to the upper portion of the instep to the insertion of the toes. The toes and the rest of the foot I had a very good example, for in the Iguandon I had at Sydenham, which was larger than this same beast, but had the inconvenience of being so much stouter that we could hardly suppose it to be possible for it to stand erect on its hind legs, as this creature must have done. I suppose, owing to the succulence of the food, and the want of exercise in roaming over one little island, lest it should "step off," as an American would say, made him so large that he was incapable of doing as much with his legs as this animal must have done. But he had a great capacity of body, so great that, in 1853, I invited twenty-one of my friends into that same body, and gave them, I assure you, a very good dinner (applause). That would not be possible, however, within the limits of this creature's ribs, although it was practically said that the ribs of the Iguandon resounded with mirth as well as good cheer on that occasion. I beg to call attention to the extraordinary fact that this creature being thus elevated upon his legs, it seems almost impossible to imagine his progression on all fours. [Drawing the outline on the blackboard.] But if we suppose the body now to be brought down to the ground in this position [drawing the outline], so that the creature could reach the ground with his short fore-limbs, it would bring him into an inconvenient attitude. We know very well that the kangaroo, of which he seems to be a gigantic representative, has the power of coming down with his fore-legs to the ground, and this creature may have done it in the same manner as the kangaroo. Now, when he brings his fore-feet to the ground, this tail takes off the weight of the body from those front limbs, allowing the creature in that attitude to progress, the tail by its weight and leverage relieving the front limbs of the weight of the body, showing us the necessity for that arrangement of the structure, which is no degree accidental; for it is impossible to overlook the design and intention of that exceptional capability of change according to circumstances, so that the very structure that would form the body of a fish, here forms the tail of a creature walking the earth, and answers by its conformation all the necessities of that structure, as I have shown you. If you will allow me for a moment I will show you that, in many respects, this is a form resembling that of the moa, an ancient New Zealand bird. You have an American ostrich, the skelton of which is the same, bone for bone, the variation being only in size. Perhaps the wing of the rhea, or American ostrich, would be a little

larger, and it has three toes. So that you have a positive existing type, excepting in regard to size, of a gigantic extinct form, supposed to be long anterior to man. I remember that when Prof. Owen first described that bird to the public, he talked of its being no longer in existence; that man had never seen the creature. But we have now evidence that men had seen the creature and knew all about it. There is incontrovertable evidence that man had seen it, and eaten it; for bones have been found near charcoal, showing that the flesh had been roasted and the eggs cooked. Dr. Mantell's son brought from New Zealand, and deposited in my hands at the College of Surgeons, the pieces of shell, charred and presenting indubitable evidence of their having been cooked, portions burned from being next the fire for the purpose of cooking the soft material of the eggs themselves. This will be some disturbance to the scientists, and particularly to the zoologists and palæontologists who have gone so positively to work to talk about man being so recent a creation, and these animals so old; and yet we find, in this case, he was very familiar with them. The history of the lake villages prove to us that man did live ages ago, or that the extinct animals, as they were called, were much nearer our own time than was previously supposed. And here, I trust that I have established the fact, that we have an intermediate form—a creature that must generally have walked upon his hind legs, as did the ostrich, as did the moa, and the rhea, the present American type of the New Zealand bird; the African ostrich, which has two toes; and other similar birds. The structure of this animal, with its two long legs and three toes, will at once remind you of the footmarks which are so abundant in this country, in the Connecticut valley. I have not seen the actual locality, but I have seen many slabs containing the footprints. These footprints were very naturally ascribed to birds by the late Prof. Hitchcock. Upon examination we find that they are the marks of feet having three toes; and we sometimes find indication of a fourth. By drawing a line around the toes, upon this paper, to show the form, you will at once see the resemblance to the impressions upon the sandstone to which I have alluded. I had prepared a slab of wet clay, in order to take an actual impression before your eyes, but the warmth of the hall has made it so dry that the weight of the foot will not give you the impression that I had intended. But you will observe that this, which is a literal outline of the two toes and the hinder part of the foot called the heel, but which is not really a heel, closely resembles

the footprints found in Connecticut valley. But I must not omit to state that those sandstones are Triassic, long anterior to the cretaceous formation in which these bones were found. I do not say therefore that it was the same creature, but that it must have been a creature remarkably like it, and that the pattern could not have altered much, either in shape or dimensions, when we find the footprints in the Triassic period so clearly agreeing with the fact of a creature which lived long subsequent, in the cretaceous period. The Hadrosaurus, of which we suppose this to be a true expression, tells us of the unity and continuation of forms, which I trust are now familiar to you from the arrangements of these bones; and I trust we shall soon be able to lay before you the restoration of the external form, now that I have shown the simplicity of the mode of producing it. For we can find the interpretation of these bones in existing animals, and put on the muscles which would be required to move the limbs, as we find them in the limbs of the alligators of the present day, or of the ostrich of the present day. We have here one type of this class of animals in the Rhea, or American ostrich; truly American, may I be permitted to say, in some of its habits; for the male is a pattern to all fathers in these days of progress, nursing the young and taking charge of the whole family, leaving the lady of the ostrich family perfectly independent, so that she can attend to political affairs without any inconvenience whatever. Doubtless you will appreciate the value of a type of that description. I do not claim as much for the Hadrosaurus. I have brought him before you mainly to show that while he is less stout than the giant Iguanodon in England, he so far resembles the ostrich in his form that he may be considered intermediate between the two; and especially to relieve your minds from any idea that there is anything profane or improper in the supposition that there may be a graduation onwards, by the change of the one original plan to adopt it to varied circumstances, and the various changes which inanimate matter must have sustained during that long period of time. [Applause.]

SCIENTIFIC LECTURE.—XI.

ON THE SPECTROSCOPE.

BY PROF. J. T. COOKE, OF HARVARD COLLEGE.

The eleventh lecture of the scientific course was delivered on Wednesday evening, February 3d, 1869, at Steinway Hall. Prof. Tillman, of the American Institute, presided, and introduced the lecturer, who said:

The color of light depends to a certain limited extent upon the nature of the source from which it proceeds. By studying the relation between the two, we have reached a new method of chemical analysis, by which we have been able not only to discover several metallic elements among the materials of our globe, but also to extend our investigations beyond the limited sphere of this planet, and to reach some knowledge, however imperfect, of the constitution of the heavenly bodies. To the course of reasoning through which these remarkable results have been attained, I am to ask your attention in my lecture this evening. All bodies when heated to a sufficiently high temperature emit light. Indeed it can readily be shown that if our theories are true, light is a necessary result of a high temperature. A bar of iron heated in a blacksmith's forge, a mass of coal burning in a grate, these gas lights which illuminate our hall, are all illustrations of this general principle. In all these cases the light emitted has no peculiar color, and is what we call pure white light; and the source from which the light emanates is in every case a solid body. Moreover, what is true in these limited instances, we find to be a universal truth, namely, that an incandescent solid always emits pure white light. But before we can deduce any safe conclusion from this general principle, we must understand what is meant by pure white light, because white light is not, as is frequently supposed, a simple sensation, but, on the contrary, a very complex sensation. It is to Sir Isaac Newton that we owe the first analysis of white light.

He found that upon passing a beam of white light through a glass prism, it became divided into differently colored rays. If a beam of light, of sunlight for example, enters a dark room through a slit in the shutter, that beam of light, as every one knows, crosses the room in a rectilinear direction, and forms on the opposite wall an image of the slit. The image is very indefinite, it is true; but if we interpose between the slit and the wall a glass lens, in a proper position, we shall obtain a perfectly defined image of the slit. If now we interpose in the path of the same beam a prism, we find that that prism produces two distinct results. In the first place, it bends the beam of light, so that the image of the slit, instead of being upon the opposite wall, is thrown very much to the left; and, in the second place, it spreads out that beam just like the rays of a fan; and instead of a single image of the slit, it forms a broad band of blending colors, such as is represented here, and which we call the solar spectrum. If now, by any means, we recombine these different colored rays, we obtain, as I shall show you at the close of the lecture, a pure white light again. From all this, it follows that white light is a very complex sensation. It is simply the confused impression produced upon the eye by the simultaneous effect of light of every different shade of color. Pure color, on the other hand, is a simple sensation, and corresponds precisely to a pure musical note. But most natural colors are not pure colors. For example, the color which the ladies call purple is a complex color, formed by the blending of various tints of red and violet. We can easily discover the different hues of which any given color consists by simply passing the light that emanates from the color through a glass prism, which will divide up the complex color into its different simple tints. On account of the great interest which attaches to studies of this kind, an instrument has been invented for analyzing colors, to which we give the name of "spectroscope." We have one of these instruments before us. It is not necessary for me to enter into any detailed description of its mechanism. In fact, the mechanism is extremely simple. It consists of the several parts I have already pointed out. In the first place we have here the slit through which the light enters. We have in the interior a glass prism which bends the light, so that the light entering from the slit passes in the direction of this brass tube, the second tube making, as you see, a decided angle with the first. Moreover, we have a small telescope, the whole object of which is to give a definite image of the slit. If we direct this instrument toward any source which gives us

a pure color, we see simply an image of the slit. If, however, we direct it toward a colored light consisting of several simple hues, we see just as many distinct images of the slit as there are separate colors. The reason is obvious. This glass prism bends these differently colored lights to a different extent. It bends the red colors the least, and the violet hues the most; and therefore these separate tints become spread out and form what we call the spectrum. If our colored light consists of a single tint, we get but a single image; if it consists of three tints we get three separate images; if it consists of pure white light, which contains every gradation of color, we get an infinite number of images of the slit, which succeed and overlap each other; and these blending images form the band which I have already pointed out.

Understanding now, I hope, what is meant by pure white light, we may return to the principles with which we started; that an incandescent solid body always emits pure light. What is true of solid bodies is also true of liquids which can be heated to the temperature at which they become incandescent, as for example, the molten metals. They also emit pure white light. Mark now the important conclusion to which this at once leads. If we can reason from analogy, it follows that whenever we see white light, the luminous source is a solid or a liquid body. So far as our experience upon the surface of the earth goes, this is universally true; and analogy would lead us to suppose it to be a general law of nature. Now the light which comes to us from the sun and the light which comes to us from most of the fixed stars, is pure white light. Then the sun and the fixed stars must be incandescent solid or liquid bodies. They cannot be vapors or gases; gases and vapors differ from solids and liquids in two important respects. In the first place, the light which they emit is far less intense than that emanating from a solid or a liquid at the same temperature. There is a great difference between gases and vapors, but, as a general rule, the denser the vapor or the gas the more brilliant the light which they emit. Hence more light is emitted by a dense metallic vapor than by the light gases, like our atmospheric air. In the second place, the light from a vapor or gas differs in that it is colored; and moreover its color is characteristic of the substance from which the light emanates. These points are very important, especially the last.

But, first of all, I must explain an apparent contradiction in my general statement. We are here burning a gas. The hall is illumi-

nated by incandescent gas, and the light of these gas flames is pure white light; and yet we have a gas and not a solid burning. But this is no exception; for the light from these gas flames does not come from the gas. It comes from minute particles of solid charcoal in the gas. The gas consists of two parts; the light gas we call hydrogen, and the solid we call charcoal, or carbon. The hydrogen forms first, and in burning it scatters through the whole mass of the flame a fine charcoal dust, what we call soot; and these particles of solid incandescent charcoal give the light. [Applause.] If we mix the gas with the amount of air required to burn it, so that each solid particle of charcoal shall be surrounded by its atmosphere with just the amount requisite for burning, then the charcoal will burn with the hydrogen, and the result is that we shall have white light. If for example, I simply open an orifice at the bottom of these burners, so as to let in a certain amount of air to mix with the gas before it is burned, then the white light disappears, and we have only the faint blue light from the gas itself. These burners, which are generally known under the name of Bunsen burners, give us a very ready means for experimenting upon the light which emanates from different incandescent vapors. Placing upon a platinum wire a bit of common salt, I will insert it in this flame. The heat of the flame volatilizes the salt, and the whole mass of the flame soon becomes filled with salt vapor, which emits its peculiar light. The light which you now see is of course a complex tint, because it is the light of the salt plus the light of the gas; but the light of the salt is so vastly more intense than the light of the gas, that it wholly overpowers it. This light is a perfectly pure monochromatic light. Salt is itself a compound body. It is composed of a metal which we call sodium, and a gas which we call chlorine, both of which emit light; but the light of the sodium is from a dense metallic vapor, and so much more intense than the light from the chlorine gas that it wholly overpowers it; and the light you see is really from the sodium vapor, and is what we call the sodium flame. [The lights in the hall were here turned down.] I will now hold before this sodium flame what will appear to you as a white card. Turning on the white light, you see that this is not a white card at all, but is really red. [Applause.] There is no red light in the sodium flame. The red color is in the light, and not in the card; and as this flame contained no red rays, we could not see the red color. We must have white light in the flame in order to see the red reflected from the card. If we point our spectroscope

toward this sodium flame, we shall see only one image of the slit; and that image will fall in a definite position in the field of the instrument. However, after we repeat the experiment we shall always find that single image in that single position. Whenever, therefore, we see a single image or band in that definite position, we know that we have sodium vapor as the source of the light.

Let us try another experiment in illustration of the same point. I will now introduce into the flame another platinum wire, on the end of which is melted a bit of another metallic element, which we call lithium. It is not the pure metallic lithium, but a compound of lithium; and you see that the lithium vapor is the source of light. The gas with which the lithium is combined volatilizes in the flame and fills the flame with its vapor; but the light emitted by the dense metallic vapor is so much more intense than the light which emanates from the gas, that the color you see is solely the color of the lithium vapor, which emits a beautiful red light. If we place our colored card in that red light you see that it appears of a very pure red color; because here the red rays are reflected from the colored card. If we examine this light with a spectroscope we see a band in this position [indicating the lithium line on the chart]; and whenever with our spectroscope we see a red band in that position we know that lithium is the source of the light. [Applause.]

There is still another method of experimenting on these vapors, which is used in fireworks. That method consists in mixing the material on which we wish to experiment with sulphur and nitre, and then igniting the mixture. The sulphur burns with a pale flame, and the metallic vapor distributed throughout the mass of this flame emits its peculiar light. For example, we have here a mixture in which the nitre has been mixed with a preparation of another metallic element we call barium; and the green light emitted is chiefly the light of the barium vapor. Again, I have here a similar mixture, in which, instead of barium, strontium has been used, another metallic element; and this red light is chiefly the light which comes from the strontium vapor, which is volatilized by the heat and distributed through the sulphur flame. This method of experimenting gives us essentially the same result as the other. In order to show you that this is the case, I have prepared here a similar mixture of sulphur, containing common salt; and while that is burning I will return to the flame of the Bunsen burner and the platinum wire with the salt upon it; so that you have here the flames of the salt burning in

sulphur, and here the same flame produced by salt burning in gas. Therefore, whether we adopt the method used in fireworks, or that of burning in the flame of gas, we have in each case simply the light which comes from the incandescent vapor of the different metals. But the purity of the light is much less in the sulphur flame, because the sulphur flame itself is far more intense than the gas flame, and tends of course to vitiate the result. We have still a third method of experimenting, which is to pass a current of electricity through the vapor, which is thus made to shine far more brilliantly than in any other way. This method I shall exhibit to you at the close of my lecture.

These experiments, then, while they have confirmed the general principles I have laid down, have also illustrated the valuable method of analysis to which I referred at the opening of the lecture. In order to discover the metals which are present in a given substance, we have only to place the material in the flame and examine the light which emanates from it. If we see a yellow band in this position, we know that there is sodium in the flame. If we see a red band in this position, we know that there is lithium in the flame. If we see the series of green bands represented here, we know that there is barium in the flame. If we see this series of red bands, and especially a beautiful blue band in this position, we know there is strontium in the flame. Moreover, this method of analysis is wonderfully delicate, and enables us to distinguish quanties of these several substances which could not have been detected in any other way. If we see a new band which has never been observed before, we know that some new metallic element must be present; and by following out the indications thus obtained, we have, within the last few years, discovered no less than four new metallic elements which have been called rubidium, cœsium, thallium and indium, names which are derived in each case from the Greek name of the color of the flame. But more than this; this method of analysis has led to important conclusions in regard to the heavenly bodies. Most of the fixed stars, and our sun, show us pure white light. They are, therefore, incandescent, solid or liquid globes. But we find in the heavens a class of bodies to which we have given the name of nebulæ. Many of these nebulæ send to us, also, pure white light. They, therefore, must consist of solid or liquid globes. But there is another class of nebulæ which send to us only colored light, and this light, when analyzed by the spectroscope, shows us certain distinct definite bands. These nebulæ

must therefore be gases or vapors; and by carefully studying these bands, and comparing their position with the bands of the metallic elements with which we are acquainted, we hope to reach some knowledge in regard to the constitution of these nebulæ and the nature of the gases of which they consist. They generally show us three distinct lines, and one of these lines has precisely the same position as one of the bands of the hydrogen spectrum. But then the hydrogen spectrum has itself three distinct bands—a red band, a green band, and a blue band. The green band corresponds with one of the bands seen in the nebulæ; but the red band is fully as bright as the green, and we find no corresponding red band in the spectrum of the nebulæ. Hence we have not yet been able to reach any positive conclusion in regard to the nature of the gas of which the nebulæ consist; but so far as these experiments go we should conclude that the nebulæ must be composed of a more elementary kind of matter than any with which we are acquainted upon the surface of the globe.

There remains one other general principle in connection with this subject which demands our attention before closing the lecture. This principle may be deduced from the well known theory of light; but we shall only have time to consider it as an established fact. The principle is this: Every gas or vapor eagerly absorbs the light which it emits itself. Thus, for example, this vapor of sodium, which is giving us a pure yellow light, equally absorbs that same yellow light. Hence, if we put behind this flame another source of yellow light, then that yellow light would be wholly cut off by the sodium flame. The sodium flame is just as opaque to yellow light of the same quality as a thick deal board; but, what is very remarkable, it is perfectly transparent to light of every other color. Hence, if we place in this second flame a bit of lithium, the light of the lithium will pass through the sodium flame, and the result will be a mixed effect produced by the light of the sodium plus the light of the lithium. You will not see, of course, pure red, but you will see red mixed with yellow; and the yellow being far more intense, the yellow will necessarily be the predominant tint. Taking the bit of sodium partially from the flame, to reduce its intensity, and make the two more equal, you see the effect produced in a more marked manner. Suppose, now, we place behind the sodium flame, not a lithium flame, but a white flame, what then will be the result? That white flame gives us light of every tint and color; and, therefore, it

gives us light of the sodium tint. Lithium did not give us light of that tint. The sodium light of the white flame will be wholly cut off by the sodium flame; for the yellow light you see is simply the yellow light of the sodium flame; and all the other colors will pass through the flame. Suppose, now, we direct a spectroscope like this, in such a way that we look through the sodium flame toward the white light, what shall we see? We shall see, in the first place, a continuous spectrum of blending colors. In the next place we shall see the sodium band projected, as we term it, upon the spectrum. Let us now alter the conditions slightly, and instead of this small gas burner use the brilliant electric light, as I shall presently show you, and then direct our spectroscope through the sodium flame toward the electric light, we shall then have the same result as before; that is, we shall see the continuous spectrum, and shall also see the sodium band; but now the sodium band will be so much darker than the brilliant spectrum produced by this exceedingly powerful source of light that it will appear black; and the result will be a black band crossing the spectrum in the position of the bright sodium bands. [Applause.] You see, therefore, that the black band and the bright band were precisely the same thing; that they mean simply a sodium light; the band appearing light or dark by contrast with the rest of the spectrum. The sodium band is illuminated only by the sodium flame. The rest of the flame is illuminated by the electric light; and the electric light being far more brilliant, of course the less brilliant sodium band appears dark by contrast. If, then, we see from any source of light a continuous spectrum crossed by a dark line in the position of the sodium band, we know that we are looking toward a solid source of light, but that that light from an incandescent solid, before it reaches our instrument has passed through sodium vapor. I have spoken thus far of the sodium band as a single one, and with an instrument of this size it appears as a single one; but if we use a powerful instrument that sodium band is found to be double. It consists of two bands, only those two bands are very close together. If we turn this instrument toward tho sun, we see a continuous spectrum, and that continuous spectrum is crossed by a dark line in precisely the position of the sodium band. Moreover, if an instrument has sufficient power, like that we have in Cambridge, that band appears as a double line, and each of its component parts coincides exactly with the position of the double sodium line. What, then, is the conclusion? That the sun,

although an incandescent solid or molten globe, sends us light, which before it reaches our planet has passed through sodium vapor; or in other words, that there must be sodium in the incandescent atmosphere around the sun. [Applause.] Now what is true of the sodium line is true of the bands of several of the other metals. Iron, for example, when converted into vapor by the heat of the electric lamp, shows us a spectrum consisting of not less than eighty distinct bands; and each one of these eighty bands coincides absolutely, not only in position but in relative intensity, with the dark bands which cross the solar disc. Then there must be iron in the sun. You can see the force of our argument if you will attempt to calculate upon this doctrine of probabilities the chances of eighty coincidences of this sort. The chances would be as millions of millions to one against such a coincidence happening by mere accident. In like manner, we have been able to prove calcium, magnesium, nickel, chromium, barium, copper, and zinc to exist in the state of vapor around the sun. On the other hand we have equal reason to know that gold, silver, mercury, aluminum, cadmium, tin, lead, antimony, arsenic, strontium, lithium, do not exist in the sun's atmosphere, at least to any considerable extent. [Applause.] But the bands whose names I have mentioned are far from accounting for all the dark lines of the solar spectrum. These, as I shall show you, can no more be counted than the sands upon the sea shore. Although we have been able to refer a hundred or more of them to a few well-known metals, the great unnumbered legion remain still unexplained. Thus much, however, seems to be established, that our sun is an immense incandescent ball of molton or solid matter, surrounded by a comparatively dark atmosphere, which is, however, itself luminous to a less degree, and becomes visible during a total eclipse, when tongues of flame are seen extending beyond the moon's dark disc. The sunlight, in passing through this atmosphere is absorbed, and hence the dark lines. Moreover we have discovered since the last total eclipse that these tongues of flame may be seen even in the full sunlight by carefully directing the spectrum toward the disk of the sun; and at Cambridge, where Prof. Winlock has observed these bands with great care, it has been established clearly that three of the bands coincide exactly with the three hydrogen bands to which I previously referred; and there can be but little doubt that these tongues of flame consist, in great part at least, of burning, or at least incandescent hydrogen. [Applause.] We have also examined the light from some of the brighter stars, and find that

their constitution must be similar to that of the sun; that is, they must be incandescent balls surrounded by an atmosphere; and although we have not as yet been able to form in regard to their constitution the same definite conclusions we have reached with regard to our sun, yet we think we have obtained sufficient evidence to say that as one star differs from another star in glory, they also differ in chemical composition. I have only been able to sketch in this lecture a rude outline of the course of reasoning by which we have arrived at some knowledge of the chemical composition of the sun, and by which we yet hope to analyze the most distant stars. I have endeavored to present the subject as simply and directly as I could, thinking that the argument would be most impressive in its greatest simplicity. Since the discovery of the law of gravitation, there has been no scientific discovery which promises so greatly to extend the boundaries of our knowledge as this. Newton gave us the rule by which we can measure the magnitudes and distances of the heavenly bodies; and now Kirchhoff and his collaborators have found the test by which we may analyze the material of which they are made. Until this great discovery, chemistry has been a terrestial science, and the glory of the heavens has been the study of astronomy alone. But now these sciences, seemingly separated by the widest gulf, have been most closely allied, and we have begun to study the chemistry of the universe. [Applause.] But we have only begun. The little which has been as yet revealed plainly shows us how much there is still to learn, and we hold our knowledge with great caution and humility. I shall not ask you to accept these remarkable conclusions wholly on trust; but having developed the theory of the subject, as well as my narrow limits would permit, I now propose to bring it to the test of experiment.

Prof. Cooke proceeded to throw upon the screen, by means of the electric light and a prism, first, the continuous spectrum of pure white light; then the bands produced by the vapors of copper, of lead, and of salt; the latter showing the sodium line beautifully clear and bright. Next he showed the bands produced by lithium, then of thallium, one of the new metals discovered by means of the spectroscope; then of brass, showing the zinc and copper lines combined. He then showed again the continuous spectrum, from white light, and interposing the vapor of salt, the sodium line appeared beautifully distinct as a dark line. He then projected upon the screen the image of the points producing the electric light; the lower point which

appeared uppermost upon the screen, being a minute cup, into which he placed successively lithium and thallium, to show the color of their light as they were vaporized. He then projected upon the screen a representation of the multitudinous lines of the solar spectrum, calling special attention to the sodium line, which was double, with a faint line between the two. He finally exhibited a circle or wheel, divided into sectors colored with brilliant prismatic colors, and the wheel being rapidly revolved, the colors were so blended as to produce almost a pure white circle.

SCIENTIFIC LECTURE—XII.

ON MODERN ENGINEERING.

By the Hon. Wm. J. McAlpine.

The twelfth and concluding scientific lecture before the American Institute was delivered on Wednesday evening, Feb. 10, 1869, at Steinway Hall, by Prof. Willam J. McAlpine. Upon the platform were seated Horace Greeley, Admiral Farragut, Gen. Callum, Superintendent of Military Academy, West Point; Gen. H. G. Wright, commanding Sixth Army Corps; Gen. Tower, Engineer Corps; Gen. Q. A. Gillmore, capturer of Fort Pulaski, Wagner, &c.; Horatio Allen, Civil Engineer, Novelty Works; Prof. Hosford, of Cambridge, Massachusetts, and Prof. Tillman of New York.

Horace Greeley, the President of the American Institute, made the following introductory remarks:

Ladies and Gentlemen: The American Institute, disappointed in being unable in the year lately closed to give such an exhibition of the products of American industry as it deemed fit or worthy of its own reputation and high character, postponed that exhibition to the year on which we have now entered; and, instead of it, resolved to give a course of scientific lectures of the very highest import and value within the power of American genius and culture to afford. It is a very common, but I think a very undeserved reproach, that New York is so intent on money making, or on pleasure, that it has no time, no thought, and no means to give to the advancement of science. On the contrary, I believe that if a project were to-day fairly presented to the rich men, and the public spirited men (who are not always the rich men) of New York, and if such a plan were to seem to them feasible and judicious, a million dollars would be freely bestowed, if necessary, for the achievement of the purpose therein indicated. The Institute resolved to test, so far as it might, the justice of the reproach commonly made that this city is given up wholly to trade and money getting, and would give no thought to any more elevated or abstract

purposes. We resolved to give the best course of lectures on science, choosing that man whom we supposed to be best qualified to illustrate each important branch or department of natural science, in its present fullest development, and with the very latest discoveries which have enlarged its area. This plan was matured, submitted to the Institute, approved by it, and the lecturers called not only from all parts of our country, but from the British provinces adjacent, where, I rejoice to say, that some of the very ablest of those who cultivate chemistry and geology, not merely as a practice but as a true science, were found. This lecture to-night is the last of the course. That course, we rejoice to say, has been sustained by the unanimous approval of the press, and by the presence here of very large and intelligent audiences, sometimes in spite of very discouraging weather. We have seen and proved that science, even abstract science, has charms for a very large portion of this community; and we shall be encouraged. While we did not expect to make money, and shall never make money by a course of this kind; while we shall expect to spend money in every such course, we shall be encouraged by the approval of judicious men given to this course, to make other, and if possible better arrangements for similar courses during the winters to come. [Applause.] The lecture this evening is on Engineering, and will be given by the Hon. William J. McAlpine, favorably known to the community as a very competent, practical, as well as educated engineer. [Applause.]

Prof. McAlpine addressed the audience as follows:

The subject of my address this evening has so wide a range, and involves the consideration of so many branches of art and science, that I have been compelled to condense my remarks, and also to omit much of an interesting character, to bring my address within the limit of the hour. It cannot have failed to have attracted the attention of such audiences as have attended these lectures that a marked characteristic of this age is the wonderful rapidity with which discoveries in every range of art and science have succeeded each other. These are confined to no one branch of human knowledge, but apply equally to all of the pursuits of study by man. They now succeed each other like November meteors; dazzling in their brilliancy, so frequent, and spread so far over the arch of heaven as not to be even counted, far less comprehended. The eminent scientists who have lectured before you, have each been profound students in their own lines of thought, and almost they only know of, or at least understand, the discoveries in their own courses of study. Our Crea-

tor has given to the human race great mental power, but to no one person sufficient to grasp all knowledge. When we have listened to the wonderful revelations into minute organism, as developed by the microscope, and find there the perfection and beauty of mechanism —or when, through the telescope, we learn of the constitution and government of those great but far distant heavenly bodies, and find there the same perfection of beauty and order; or when the spectroscope, photometer, and barometer tell of the constituents of matter around us; or when an essay on the simple tea-kettle informs us of the practical application of knowledge to one of the most useful and powerful of the agents of modern progress, *then* we realize how impossible it is for one mind, however capacious, to grasp even a tithe of the discoveries which are daily being made. My subject (modern engineering) requires a comparison of the past with the present. *Then* discoveries were of rare occurrence, and still more rarely applied to the useful purposes of life—*now* they are not only very frequent, but are immediately applied to the safety, comfort and convenience of man. The natural capacity of the mind of man has not increased, and therefore there must be some other explanation of its present changed condition. An enthusiast, like Dr. Cummings, reasons from it that the millennium is approaching, and another that intercourse with the immaterial world is at hand—but the subject is too profound for our finite minds, and similar to Divine prophesy, "the event is necessary to its solution." An idea attributed to Bacon is that, as in all animate life, thought must be impregnated by thought, to produce any useful result. In ages past intercourse between man and man was limited. He lived and died without having traveled beyond the horizon seen from his birth-place. Learned men were confined to cloisters. They rarely met, and their reflections were only occasionally set down in manuscripts, the circulation of which was confined to a few readers. Hence by this Baconian theory but few scientific discoveries were ever made, and these were but seldom applied to the useful purposes of life. This age, on the contrary, presents the opportunity for frequent meetings and comparisons of thought. The steamer, with its ten days of confinement, produces intercourse between minds which otherwise would have never met. The railway car, with its rapid motion, exciting thoughts in the dullest traveler, brings other minds in contact. A prolific press sends forth the thoughts of each writer, to encounter those of other minds engaged in the same, or some kindred pursuit. While the telegraph

daily sends the report of one, or more discoveries, to stimulate the minds of some of the millions whom it reaches, to the consideration of the same, or some corresponding line of thoughts. In all of these communions, the cruder thoughts of each person are cast into the crucible with those of a thousand other minds, by which errors are eliminated and useful suggestions generated and the grand discoveries to which I have alluded to are produced. The profession of engineering is peculiarly the exponent of this modern development. Its definition is "The acquisition of that species of knowledge whereby the great sources of power in nature are converted, adapted, and applied for the use and convenience of man." *

Under this definition is embraced the civil and military engineer, the architect and mechanician, the closet theorist, and the practical workman. Nevertheless, there is a broad distinction between the one who designs and plans an elaborate machine, and him, who with no scientific knowledge, merely constructs it, and him who with no requirement of either mechanism or science, is merely employed to direct its movement, and yet in common conversation the term "Engineer" is indifferently applied to each. I shall presently lay before you at greater length, the effect of the great discoveries and applications made by this profession upon modern progress, and in this place will merely name, the locomotive and its railway, the steam engine and its applications, the hugh masses of metal and their manipulations, the workshops and their great tools, modern ordnance and armor, naval construction, telegraphy, bridges, canals, water supplies, harbors, etc. The mere mention of these, is sufficient to give you an idea of the broad field which is covered by my subject, and why, as stated at the beginning, I have been compelled to condense and omit so much. Under these circumstances, I have considered it better to direct my remarks to the most important branch of the profession (civil engineering), with such incidental allusions to the others as may be necessary. The term "modern" will require some comparisons with that of ancient engineering, and I will give very briefly a few of the leading points in the history of the profession so as to define the "modern age."

ANCIENT ENGINEERING.

Referring to Divine history we find that the first mechanician (an antediluvian) was "an instructor of every artificer in brass and iron,"

* NOTE.—This is the motto of the Institution of Civil Engineers of London, and is embodied in their certificates of membership.

and that the first naval engineer constructed a vessel which has only once since been exceeded in size; and that the first architect built "a city and a tower," which became one of the seven wonders of the heathen world. We find, also, the architect of the Tabernacle, who was "learned in all of the knowledge of the Egyptians," and him of the first Temple, who was endowed by God with "wisdom and knowledge" beyond that of any other man, and him, also, of the second temple, who was possessed of all of the learning of the Chaldeans. In profane history, we find Hercules deified for draining the marshes of Thessaly; and the first bridge builder, Semirimus, whom we are the more proud of classing in our profession, as she was a woman, and who is also said to have tunneled the Euphrates, constructed canals and reservoirs for irrigation, and commenced the walls and hanging gardens of Babylon. Of Phidias, the constructor of another of the seven wonders, who built the first water works of Athens, tunneling Mount Athos for two miles, with a passage of eight feet diameter; of Archimides, the military engineer, who defended Syracuse so long by his science alone, against the whole power of Rome; and of Vitruvius, the analyst, by whose engineering rules we are yet governed. But the early history of the profession has been best written in its monuments, extending from the days of Abraham to those of Constantine. In the great temples of Assyria, Egypt, and India, and those of the central and southern American continent; of the long canals for transport or irrigation in China, India and Egypt; of the water works, with their tunnels through mountains; acqueducts over valleys; immense reservoirs, and systems of pipes, and in the great military roads, bridges, and sewers, of the Romans. These histories bring us down to the first centuries of the Christian era; the Augustan age of ancient engineering; after which civilization was overwhelmed by or lapsed into barbarism, and engineering was only practiced by a secret fraternity of masons, "The Brothers of the Bridge."

Modern Engineering.

With the revival of civilization in the seventeenth century, dates the commencement of modern engineering, though the term will be more particularly applied to the last hundred years. This revival began in Italy, in the construction of canals for irrigation, and subsequently with those for transport with locks (which had not been used before that time); in the investigation of the laws which govern the flow and pressure of water, and in the construction of great hydraulic

works; bridges over rivers, harbors and docks, and the reclamation of lands under water. The great canals of France, Holland, and Great Britain, and the improvement of rivers; the thousands of acres of wet docks in England and France to overcome the inconvenience of the tidal wave, harbors and light-houses, show the progress of the profession for the next two centuries. The last century has been characterized by the application of steam to water and land transport, and to every variety of mechanical operations, to the product and manipulation of metals, to telegraph, and to printing in its various improved forms. Some of the most distinguished of the earlier of the modern engineers were recruited from other trades and professions, and were drawn into it from circumstances, or a natural inclination toward the study of the physical sciences. With the continued advance of refined civilization, the demand for this service called for a higher degree of elementary education, until it has required from the modern engineer not only the highest degree of knowledge in the physical sciences, but also long practical experience and sound judgment in the application of such knowledge. During this period the profession, as in all others, has suffered somewhat in the public estimation by pretenders, quacks, and charlatans. The wide dissemination of knowledge among our American people has now reached a point which enables the claims and merits of an engineer to be fairly judged, and henceforth such pretenders will be employed only in schemes of doubtful expediency, or by those who are themselves but little acquainted with the ordinary principles of science. The ordeal of criticism by our daily and other periodical journals serves not only to expose such pretentious claims, but also to restrain the eccentricities of genius, and now compels the engineer to the enunciation of purely practical plans.

THE LOCOMOTIVE.

I have referred to the effect of the great discoveries and appliances of engineering upon modern progress. The first of these of which I shall speak is the locomotive, a machine of purely modern invention. When I first entered the profession, but little more than forty years ago, it had not been successfully used anywhere, and was almost wholly unknown in this country. At the beginning of this century, a rude machine of this kind was invented by our countryman, Oliver Evans, and, a few years later, was reinvented in England; and after the trial of many modifications and expedients, during the succeeding

twenty-five years, the celebrated trial of locomotives was had at Liverpool, in 1829. Stephenson won the prize at this trial with the Rocket (which is now kept on exhibition at the Kensington Museum), an engine which weighed but four and one-quarter tons, ran fourteen miles an hour, and hauled a gross load of seventeen tons. To exhibit the progressive changes in the locomotive, the maximum speed attained at different periods will be given. In 1834 it was twenty miles an hour; in 1839 it was thirty-five miles; in 1847 it was sixty miles; and since that time a speed of 100 miles an hour has been attained. The first locomotive in the United States was driven by horse-power, in 1829, and attained a speed of ten miles an hour, and was designed by Mr. Detmold of New York, who the next year built a steam locomotive for the Charleston, S. C., railway. In 1829, Horatio Allen, of New York, brought over two locomotives from England for the Carbondale railway. In 1830, Peter Cooper placed a small one on the Baltimore railway; and in 1831, John B. Jervis placed two upon the Albany railway, one of which was built in England and one at the West Point foundery. There are now some 15,000 locomotives on our American railways; and on one line in England there are about 3,000. The usual weight of the locomotive is now thirty tons; but there are a great many in use of forty, and a few of fifty tons. M. Petiet has placed twenty-five locomotives of sixty-nine tons weight upon the Northern railway of France, to run the express passenger trains between Paris and Dover. These are mounted on twelve drivers and carry their own wood and water. It was *once* considered that curves of less than half a mile radius, or grades of more than fifty feet per mile were inadmissible. *Now* curves of 500 feet radius and grades of 100 feet per mile are common. The temporary railway over Mount Cenis has long grades of 440 feet per mile, over which all of its traffic is conducted by locomotives grasping a central rail. Some years ago there was also a temporary track on the Baltimore railway of 528 feet per mile, up which the locomotives daily hauled twice their own weight. Forty years ago Mr. Allen had to mount the foot-board of the first locomotive and run it himself. Not a mechanic in the employ of the railway company dared to let loose this monster. *Now*, 15,000 of them are daily whirling over 40,000 miles of railway in this country alone, and nearly twice as many in the rest of the world. To-day locomotives are passing over the summits of the Rocky mountains and of the Sierra Nevada—more than 8,000 feet above the level of the

sea—and facing each other in the great Salt Lake Valley, and and before the year closes they will pass over 3,000 miles of continuous railway from the Atlantic to the Pacific ocean. What changes have this *one* engine of the profession brought about in the condition of society in this country? From the days of Noah until those of the locomotive, civilized population all over the globe was confined to the rivers, lakes, and borders of the oceans, or a day or two's ride into the interior. The mariner's compass carried this population across the Atlantic, where, following the same law, our settlements were confined to the vicinity of these water-courses. As soon as the locomotive was inaugurated, our railways were pushed forward into the interior of those immense fertile districts of the west, and they were populated with unexampled rapidity, and then began that era of prosperity which has raised our country to its eminence among the nations. This era has been unlike any which has preceded it in the world's history. An avalanche of people upon a wilderness almost in a day. Not like those northern hordes upon the civilized plains of Europe and Asia to lay waste and destroy, but a migration of the highest degree of civilization upon barbarism, to build up and create. Without the locomotive these fertile lands, their wealth of minerals and forests, their great cities, their industrious, wealth-producing population—yea, more than one-half of the population and sources of our prosperity would have remained undeveloped for ages, perhaps forever. But there are too many of these engines of the profession to allow me to dwell long upon any one of them. The second one to which I will refer is the application of steam to the propulsion of vessels. This has covered every ocean, lake, and navigable river with fast moving, deeply laden vessels, conveying the people and products of different climes and nations to others, and enhancing the comfort, convenience, and profit of all. You will remember that all this has been accomplished during the 19th century, and that the chief development has been made in but little more than thirty years. Twenty years ago a voyage of twenty days across the Atlantic was called a quick passage; now it is made in eight, and will soon be made in six days. Indeed, the question of speed on either land or water may now be determined by the public. Almost whatever speed it is willing to pay for, the engineer is ready to furnish. The construction of railways and steam vessels has called into requisition the highest engineering skill that the world has ever known. Bridges of extraordinary span and strength, vessels of immense burden, machinery of great power, mas-

siveness, and accurate workmanship. The Britannia and Niagara bridges are but types of thousands of similar structures all over the world. The Great Eastern steamship of 22,500 tons is premature by only a few years, for those of 6,000, 7,000, and even 9,000 tons are now built. And the enormous engines and ponderous masses of metal required by them, have taxed the inventive power of the mechanicians.

Canals.

The great canals executed in our day form an important feature in this progress. I shall endeavor to illustrate my subject, as far as possible, by American examples, and will, therefore, next refer to the Erie canal, and the more so, because in conversation with many, otherwise well informed persons, I find that they do not fully appreciate the importance of this great work upon nearly all of the interests of this city, of this State, and of the nation itself. With many persons there is an idea that the railway has superseded the canal, and that the former now performs the chief part of the traffic of the country. While the latter is true in regard to interior short lines of trade, it is a serious error, in reference to the great transport between the agricultural west and the Atlantic. The Erie canal, during the season of navigation, conveys more of this traffic than all of the railways together; more than all of the trunk lines from the St. Lawrence to the Potomac. The boats which come to tide water have an average cargo, exceeding that carried by the longest freight train on the Central railway. During the busy season more than 150 such boats arrive daily, and their tonnage would require more than 150 freight trains. The greatest number is but thirty per day on the Central railway. The Erie canal, therefore, is performing more than five times as much business as the Central railway. Yet the slow plodding canal boat attracts no attention, though burdened with more tons than the bustling, noisy, whirling freight train, which creates a sensation in every village through which it passes. The 4,000 canal boats, of an aggregate of 1,000,000 of tonnage, moving 5,000,000 of cargo per annum, exceeds the tonnage of all the vessels engaged in the foreign commerce of this city (even before the war). In another place I have alluded to the great trade of the west, which will soon exceed the capacity of even this enlarged canal, and require it to be again enlarged for vessels of 1,000 tuns, or three times those now in use. A few days since the State Engineer informed me that there

had been used, up to this time, more than 2,500,000 of tons of stone in its works of masonry, and more than 75,000,000 of tons of earth and rock in the construction of its channel, more materials than will be used in the building of the 2,000 miles of the Pacific railway. The works for the public supply of water to all our great, and to many of our smaller cities and villages, deserve mention. There is hardly a town, especially in the northern section of this country, which has not a public water supply, and the engineering works of the most of them have been skillfully executed. But there is no work of this kind in the world which will compare in engineering merit with the Croton, in the designs for its structures, and their construction in the most skillful and durable manner, without unnecessary expenditure, and solely for utility, and at a cost so moderate as to astonish the profession.

Bridges and Foundations.

Our American examples of bridges are almost without number, embracing those of nearly every material and form, and many of them of huge proportions. Among the most noted of these are, the Niagara and Cincinnati, of wire, suspension, by Roebling; the Havre de Grace, of wood, by Parker; the cast iron arched bridge at Philadelphia, by Kneass; the Victoria (Montreal) bridge, by Stephenson (a duplicate of the Britannia iron girder bridge), with hundreds of others, equally deserving of mention. The submarine works, executed by our American engineers, have required a degree of science and skill, at least equal to that demanded for any European work. The most important of these are the founding of the piers of the Potomac and Croton aqueducts; of the Havre de Grace and Harlem bridges; and the foundations of the United States Graving-dock, at Brooklyn. A brief description of the latter will serve to explain the engineering difficulties which were also encountered in the others. This structure weighs 75,000 tons, and is sustained on a quicksand of more than a hundred feet depth. The foundation had to be placed at a level forty feet below that of the sea, and rendered perfectly unyielding. The sea water had to be shut out by massive coffer-dams, which were twice undermined by the pressure of the water; and the land portions of these dams—subjected to the pressure of the liquid quicksand, of nearly twice the weight of water—repeatedly broke the chain cables by which they were secured (these cables being the best bowers by which our largest men-of-war ride in the

heaviest storms). Fresh water springs, with a head far greater than that from the sea, again and again undermined the piles (driven nearly forty feet), and forced up large areas of the foundation by their hydrostatic pressure, although heavily loaded. The superstructure of the finest cut granite, in which the slightest yielding would have been perceptible, stands to-day as firm as if founded on solid rock. The Harlem bridge has been mentioned, because of the novel construction of its piers, and a growing opinion, on the part of American engineers, that this system of founding piers in difficult places will, in this country as in Europe, supersede those heretofore used. These piers are composed of large cast iron columns, six feet in diameter, fifty feet long, and fifty tons weight each. These enormous piles were driven twenty-five feet deep into the gravel and rocky bed of the river, by the modern invention of the pneumatic process, by which, with a six-horse engine, an air pump, and a dozen men, these huge masses of iron were handled with certainty and ease. I have stood on the platform, and, with a turn of my wrist, sent this fifty tons plunging downward with almost frightful velocity, and then arrested it within the fraction of an inch of any desired depth. The eastern terminus of the Pacific railway at Omaha is now being connected with the railways on the east side of the Missouri by a bridge whose piers will be of cast iron columns of eight feet diameter, driven eighty feet below the bed of the river by the same process.

Machines.

The civil engineer, however, has been enabled to accomplish some of his most important undertakings, through the instrumentality of the large masses of metal and the workmanship thereon, and by means of the great tools and engines with which he has been furnished by the skill and genius of the mechanical engineer. A mass of bronze or of iron of a ton weight, of specific form and workmanship, was almost, if not quite, unknown before the Christian era. Now we have those in cast iron of from 100 to 150 tons, and in common use of from forty to sixty tons. In wrought iron of thirty to forty tons, and in steel or bronze of twenty-five tons, cast in any desired form, and planed, turned or bored with an accuracy and finish equal to that of the works of a delicate Geneva watch. Bessamer has an anvil block of cast iron, made at one casting, of more that one hundred tons, and Krupp has another of one hundred and fifty. But neither of these required the skill which produced the bed-plate of the

Adriatic (Collins's steamer) of sixty-five tons, cast at the Novelty Works ten years ago, or those frequently made at other shops. The casting of the former could be protracted through two days, the latter had to be cast in as many hours, or they would have been ruined. Ten years ago Mr. Allen cast and bored a steam cylinder of sixty-four square feet area, in which he gave a dinner party, and seated twenty-four persons. I have recently examined some of the largest "tools," as they are technically called, in the great workshops of the country, and have received from the proprietors statements of their dimensions and capabilities. Although my business requires me to study this part of the profession, I confess that I cannot keep up with the constantly increasing proportions of these leviathan tools. Two years ago I examined the largest lathe in England (Forrester's at Liverpool), which swings twenty-two feet, and will take in a shaft of forty-five feet length. Six months ago I saw one at Corliss's, at Providence, which swings thirty feet, and will take in a shaft of fifty feet. In the former was turned off the main shaft of the Great Eastern, which weighs twenty-two tons. The shafts of the Bristol and Providence (Sound steamers) also each weigh twenty-two tons, and those of the China steamers Japan and Great Republic weigh thirty-three and thirty-four tons, and they were turned off in American lathes. Corliss has recently cast pulley fly-wheels of thirty feet diameter and nine feet face, weighing fifty-six tons, and turned them off in his large lathe, and he is now finishing off a spur-wheel of the same diameter, weighing forty-five tons, and cutting on the face by machinery, cogs of twenty-four inches face and five and a quarter pitch. During the war he turned off twenty-five brass turret plates for our monitors, of twenty-five and a half feet diameter—having at that time the only lathe in this or any other country in which they could be turned. He has a planer which planes iron of fifty feet length, and others of ten feet height or width. At the Boston Navy Yard, is a machine, just set up, which will plane a piece of iron sixteen feet long, eighteen feet wide, or fourteen feet high. At the Morgan Works there is one of these machines that will plane twenty-seven feet long, fourteen feet wide, or twelve feet high, and a slotting machine that will cut a face of eight feet diameter, and seven feet high. There is also a boring mill at this shop which will finish off a cylinder of 130 inches diameter and eighteen feet stroke. These planers and slotters cut off shavings in iron of two and one-half inches width and nearly a quarter thick, and some of them are arranged

with several of these cutters, all working at the same time. The rolling of the enormous plates for the iron-clad vessels requires, also tools of immense size and power. But time would fail me to describe the power and majesty of these perfect, though ponderous tools. They furnish to the modern engineer thunderbolts more powerful than those forged for Jupiter. But they are used to build up and create, not to destroy.

Military Engineering.

Not long since I witnessed the penetration of a wrought-iron shield for an embrasure, made of two plates measuring together fifteen inches thickness, by a cannon shot of twelve inches diameter and 624 pounds weight, fired from a constructive distance of 500 yards, and a distinguished officer remarked: "Gen. Rodman has in reserve his fifteen and twenty-inch guns, but American engineers and mechanicians will soon furnish us with shields strong enough to resist even these enormous projectiles." The active force of the powder on the ball was 40,000 pounds per square inch, equal to 2,250 tons, giving it an initial velocity of 1,200 feet per second, or 800 miles an hour. The weight of spherical cannon shot are as the cubes of their diameters, and therefore one of twenty inches is five times as heavy as one of twelve inches. The "work" of a cannon shot is in direct proportion to its weight and the square of its velocity, and the effect of rifling the gun is to largely increase the effect of the shot and its range. The largest American gun weighs fifty-eight tons, and throws a ball of 1,072 pounds. Krupps' great steel rifled gun of fourteen inches bore, weighs fifty tons and would throw a ball of 1,000 pounds. It has never been fired. The largest English gun that has been tried, with a moderate degree of satisfaction, is the thirteen three-tenth inch Armstrong rifle, weighing twenty-six tons and throws a shell of 610 pounds; but these have all burst; and even the twelve-inch English gun is as yet an experiment. The twelve-inch Rodman rifle, weighs twenty-six tons and throws a solid elongated shot of 630 pounds, and even a steel shot of 684 pounds. The "Swamp Angel," used at the seige of Charleston, weighed eight and one-quarter tons. It was an eight-inch Parrott rifle, and threw shot of 150 pounds into Charleston, from a distance of five and one-half miles. The foundation of the "Swamp Angel" was a novel one. It actually rested on fluid mud, sixteen feet deep; but the mud was confined in a square box of forty feet, made of sheet piles, driven into the sand below and made "mud tight." The platform of the gun (including the gun,) weighed twelve

tons, and was a mud-tight piston, fitting the box tightly. The great ancient rival of the "Swamp Angel" was the "Mons. Meg," now at Edinburg Castle. It is thirteen and one-half feet long and twenty inches bore, with a powder chamber of nine and three-quarter inches diameter, and the charge was a "peck of powder." The balls used were of stone, eighteen and one-half inches in diameter. It was used at the siege of Dunbarton in 1489, and was injured in firing a salute in 1682. There used to be a quaint inscription upon it, about in these words:

> "Load me well, and sponge me clean;
> And I'll drop you a shot at Calais Green,

sixteen miles. There was some poetic license used by this ancient rhymster, for one of our distinguished engineer officers informs me that with the most liberal allowances, in his calculations and with the advantage of ricochet on water, this gun could not possibly have had a range exceeding one and a half miles.*

The capture of Fort Pulaski, near Savannah, affords a good illustration of the unerring certainty of the calculations of the effect of ordnance by modern military engineers. The breaching batteries had to be placed at a mile from the fort. The engineer (who is also a member of our civil society) prepared his plans before leaving Washington, complete in every particular. I cannot refrain from using the general's own words, although stated at a social meeting, they have so thoroughly the ring of the true metal of the engineer, who, with science, experience, and judgment, *knows* the result of his operations *before* he begins them. He said: "The capture of that work had been calculated and worked out on paper, with an almost absolute certainty, of the preëstimated results, and I had almost as much confidence in my ability to breach the walls, as if I had gone to work on them with masons, hammers and chisels." Whitelaw Reid, in his "Ohio in the War," says: "On the evening of April 9, 1862, Gen. Gillmore issued his order for the bombardment. It was remarkable for the precision with which every detail was given. The directions for the breaching batteries will illustrate." [Here follows Gen. Gillmore's order.] Mr. Reid continues: "These instructions, with few exception, were adhered to throughout. For their striking illustration of the unerring as well as preëstimated results of applied science, engineers and artillerists will hold them not among the least

* It should not weaken confidence in these calculations when I add that they were made by the gallant officer who had the direction and firing of "Mons Meg's" great rival, the "Swamp Angel."

remarkable features of the siege. They were addressed to raw volunteer infantry, absolutely ignorant of artillery practice until the siege commenced, and taught what little they knew about serving the guns in the intervals of leisure from dragging them over the beach into battery," &c., &c. A modest pamphlet of forty pages was published at the end of the war. It is the Report on Military Railways. By a summary of their operations it appears that at one time there was a force of 24,964 men employed, 2,105 miles of railway were operated with 419 locomotives and 6,330 cars, and there was built and rebuilt 641 miles of railway, including twenty-six miles of bridges, and the whole expenditure of the department, after deducting the materials sold at the conclusion of the war, was a little under $30,000,000. When Gen. Grant advanced from Washington, on his final campaign, the Rappahannock bridge, 625 feet long and thirty-five feet high was rebuilt in forty hours, and the Potomac bridge, near Acquia creek, 414 feet long, and eighty-two feet high, was built in the same number of hours. Fourteen miles of the railway was rebuilt in eight days, and was used for only one week, to convey 8,000 wounded men from the battle fields of the Wilderness and Chancellorsville. On the evacuation of Richmond by Gen. Lee, the railway was relaid, and put in operation as fast as the troops marched. The order was that the railway must be completed to headquarters every night. Frequently the construction corps advanced with a completed railway, faster than those who were employed in laying down the telegraph lines. At the West, on General Sherman's march from Chattanooga to Atlanta, in May, 1864, the railway was constructed and "kept pace with the army." The Chattahoochie bridge, 780 feet long, and ninety-two feet high, was built in four and a half days. In October of that year the rebel General Hood passed around Sherman's army, and destroyed thirty-five and a half miles of the railway, and 455 feet of bridging. In thirteen days after he had left the line was restored, and the trains run regularly. In one case, twenty-five miles of track and 230 feet of bridging in one stretch, at Tunnel Hill, were reconstructed in seven and a half days. In February, 1865, General Forrest destroyed a long line of this railway, and in thirty days it was reconstructed, including 2,200 feet of bridging. General McCallum says: "Had any failure taken place, either in keeping these lines in repair, or in operating them, General Sherman's campaign, instead of proving, as it did, a great success, would have resulted in disaster and defeat." General Callum told me that

on the march to Atlanta some rebel prisoners (old graduates of the academy) expressed their astonishment at the wonderful rapidity with which the railways were reproduced. "While bridges were yet burning your men had often commenced their reconstruction, and before the cannon were out of hearing trains were crossing them." The reply was that General Sherman had duplicate railroad bridges always ready. But said another, "Your progress will be arrested at Tunnel Hill, for we have blown up the tunnel." "I doubt it," said a companion, "for the Federals have also probably a duplicate tunnel on hand." The application of steam to the various purposes of manufacture, is worthy of a lecture by itself, and one can only realize its extent when passing through the numberless workshops in our Eastern cities and villages. I shall say no more on this subject at this time, except to call your attention to the recent successful movements to apply steam power to agriculture. We have seen the resulting benefits from the introduction of the mowing machine, cultivator, and reaper, but we are soon to witness all of these as well as plowing done by steam power. The effect of this will be to bring thrice the number of acres at the west into use, and increasing the crops more than three times as much as now.

TELEGRAPHY.

Telegraphy may, with propriety, be considered one of the branches of engineering, and is peculiarly of modern development. A clever writer says that it may be read by each of the five senses. On land lines each signal is made by suspending the flow of the electric current, for two different intervals of times, called "dots and dashes"—the use of which, in different orders, constitutes the alphabet of the telegraph. When these are printed they are read by "sight," but ordinarily the operator reads them by "sound," as easily as the musician reads the letters of the scale by the same sense. If the operator has no instrument, he will grasp the wire in his hands, and read the signals by "feeling" the intermissions of the flow of the electric current. In like manner, by placing the wire across his tongue he can "taste" the same intermission (but this is a dangerous experiment). And it is said that the electricity can be made to dissolve a chemical and produce a pungent odor in the telegraphic alphabet, which can be read by "smelling," but for this I do not vouch. I believe that the method of signaling through the Atlantic cable is known in detail to but few persons. The operation is exactly reversed from

that on the land lines. The gutta percha covering of the copper wires, under the pressure of a great depth of water, becomes an absorbent of the electricity which is being sent through them to the extent of ninety per cent. The first portion of the electric wave of ten per cent crosses the ocean (1,700 miles) in two seconds, and it would be followed by a succession of waves from the restoration of that portion of the electricity which has been absorbed by the gutta percha in impulses, and the signal would be repeated like echoes, and produce not only confusion, but great delay. To remedy this, Professor Varley introduced a key, which sends alternate currents, positive and negative, at such intervals as allow the first wave of ten per cent to pass forward, and then that portion absorbed by the covering is neutralized by its opposite, and the cable is cleared for the transmission of a second pair of currents. The battery used is a very small one (three of Daniels' cups), and the signal, being only ten per cent of this small current, is powerless to move any of the other instruments in use on land. The instrument used consists of a minute polarized needle, suspended on a single strand of a spider's web, or one from the silk worm. In the middle of this minute needle is placed an almost microscopic mirror, which reflects a single ray of light from a powerful lamp. The currents of electricity deflect this needle alternately to the right and left for a space of time corresponding to that occupied in the signal on the land line, the same kind of alphabet being used in both cases. The receiver (not operator) sits in a dark room, and the small mirror reflects the ray of light upon a piece of white paper before him, on which a black line is drawn, to the right and left of which the light is alternately reflected. The receiver reads these signals by "sight," and transmits them to another person, placed outside of the dark room, by means of an ordinary instrument. A short time since, Gen. Reynolds told me that he had sent a message, without either a wire or a cable, ninely-two miles, across an arm of Lake Superior, by means of the Heliotrope or mirror, and on the return of his messenger (who had been sent with a written copy), he found that the Heliotrope message had been received, understood and obeyed. He had two assistants, who had been telegraphic operators, who had for the whole summer been amusing themselves in talking to each other with these instruments, though they were stationed ten, twenty, or thirty miles apart. When the rebel Gen. Morgan made his great raid through Indiana and Ohio, he captured one of my operators, and

compelled him to telegraph, in Gen. Lew Wallace's name, to Cincinnati, asking how many regular troops were in that city. Morgan read by "sound," and, therefore, the operator did not dare to intimate that he was under duress, and could only venture to add an extra initial to his own signature. The receiving operator at Cincinnati knew that Morgan was in that neighborhood, and suspecting, from the extra initial letter, that all was not right, replied, greatly exaggerating the force of regulars; and the consequence was that Morgan changed his route to a circuit of twenty miles beyond the city, and thus saved it from a sack, and the probable loss of millions of dollars.

Ancient and Modern Engineering Compared.

The consideration of the subject requires me to contrast modern engineering with that of former times. In the early ages the duties of the architect and engineer were combined, and we must refer to the works executed by the former for the practical examples of the latter. One of the results of a high degree of civilization is the division of labor, by which a greater perfection is attained by those who devote themselves to one pursuit, than when their studies are directed to several different, even though they are analagous ones. It is this condition of society which has, in modern times, separated these professions. As now understood, the former (the architects) are men of educated taste, who apply themselves almost exclusively to the designing of public and private buildings, while the latter (the civil engineers) are men of scientific mechanism, who are chiefly engaged in designing and constructing roads, railways, canals, water works, and their necessary mechanical adjuncts. In a comprehensive sense, engineering also includes architecture, as a mechanical art, in distinction to it, as a fine art. While the duties of each run somewhat into the field of study of the other, yet they are, and ought in practice to be, separated, so as to give the highest degree of perfection to each. The engineer is required to follow the exact rules of mathematics, the stern deductions from science, and the rigid laws of mechanism, all of which unfit him for the higher flights of taste and imagination, which distinguish the architect. While the consideration of these laws, and the details of construction dwarf the genius and taste of the architect. The works which the engineers in both ancient and modern times have been called upon to design and execute, are confined to those which are required in a highly cultivated condition of society, and where the accumulations of the profits of past industry furnish the

pecuniary means. To some extent, therefore, their works belong to the luxuries of the age; nevertheless it may be said of those of modern times, that they are in an eminent degree those which are of the highest practical value to society. The wealth and prosperity of any country depends upon the skill and amount of its labor, usefully applied. The dense population of semi-barbarous nations, like China, lack this skill and application. The frozen regions prevent, and the torrid ones destroy, the inclination to labor. It is in the northern temperate zones that we find the greatest amount of labor and skill in its application, and through this belt shall we find our chief examples of engineering. It is the peculiar duty of the engineer to instruct and direct labor; and his value in his calling depends greatly upon his knowledge of, and ability to instruct in, the best methods of applying either skilled or unskilled labor. The works of the ancients are often referred to as excelling in magnitude, accuracy of workmanship, and beauty of design those of modern times. This view is, in part at least, quite erroneous. The engineers of those days were employed by rich and powerful patrons, who furnished them numerous though generally unskilled laborers; materials without regard to cost, and money without stint. Their works bear evidence of these conditions, and were chiefly confined to monuments of useless victories, or constructions in compliance with the whim or caprice of the monarch, or in deference to their idolatrous worship. Yet there are exceptions. The transport canals of Egypt and China, those for irrigation in India and Assyria, the water-works all over the East, the vast military roads which radiated from the Imperial city, and extended to the extremity of the empire, the bridges over rivers, and the ports and harbors of the inland seas, all bear evidence that these engineers were often called upon to plan and execute works designed for utilitarian purposes. While the great canals of China and those of Egypt were but imitations of the natural water courses, without locks, yet many of the other works referred to, and especially those constructed by the Roman engineers, are fine examples of professional practice. In alluding to the great works executed by the ancient architects, mention must be made of the Temple of Baalbec, wherein are found the largest stones (save one) in any building in the world. Three of these measure 68.64¼ and sixty-two feet in length, fifteen feet in height, and from the fourth corresponding stone yet in the quarry, but broken, the widths are also fifteen feet. Bayard Taylor calls these stones 8,000 tons weight, but by the above measurement the

largest stone weighs 1,275 tons. The quarry from which these stones were taken was within a mile of the temple. The Monoliths of Egypt are from two to three hundred tons, and a few of 700. The obelisk of Luxor, now in Paris, is of Syene granite, and weighs 250 tons.* The covering of a tomb at Ravenna is a single stone of thirty-four feet diameter and four feet thick, and weighed when quarried 1,000 tons. The "goodly stones" of the temple, to which the Disciples called our Saviour's attention, according to Josephus, were of the "whitest marble, upward of sixty-seven feet long seven feet high, and nine feet broad," and therefore must have weighed 350 tons. Eusebius, a profane writer, says that the Lieutenant of Titus tore up the foundations of this temple, so that Christ's remarkable prediction, "That not one stone should be left upon another," was literally fulfilled within fifty years after it was delivered. I cannot better illustrate the comparison of modern with ancient engineering than by describing, from the most trustworthy sources, the probable method of constructing the Pyramids, having particular reference to that at Gizeh, or, as it is often called, after its builder, "The Cheops." The engineers of that day had iron only in its malleable form, and did not possess the art of converting it into steel, and thus obtaining its high hardening power. They used other metals and alloys, chiefly bronze, or copper, hardened by tin or zinc. They doubtless split out their large columns from the solid ledges of rocks, like those of the Syene granite, with fire and water, as we often now see a farmer split up a hard and troublesome bowlder. They worked these stone roughly into shape with their bronze tools, and subsequently by the tedious process of rubbing down the surfaces with stones of still firmer texture. This Pyramid was chiefly made from a soft limestone obtained from the opposite side of the Nile, but some of them came from quarries more than 100 miles distant. The smaller stone were hauled on land by oxen on sledges, and the remains of rude wooden tramways are still extant. The large stones were hauled by men, who could work in concert, to the sound of music, as shown in some of the Egyptian drawings. By calculation I find that to haul a stone of 300 tons, on level ground, 1,000 men would be required. Herodotus mentions one column at Sais in Egypt, which by calculation weighed 718 tons, which, he says, required 2,000 men for three years, to haul it from the quarry, about 100 miles distant. Our modern wooden scaffolding, or machinery for hoisting

* The French engineers were three years transporting it from Thebes to Paris.

was unknown, and instead of them, an enbankment was made around the structure, as an inclined plane of earth, both of which were raised up, as each successive course of stone was laid, and when the structure was completed this earth was removed. The strong mortars and cements of the Romans were unknown. They had to depend for the stability of their walls upon the massiveness of the stone, and the close fitting of the joints. This great pyramid, with a base of 700 square feet, and 450 feet high, contains 6,500,000 tons of stone, and the embankments would have required more than 50,000,000 tons of earth. You will be better able to realize these figures when I repeat that all of the masonry on the Erie canal amounts to but 2,500,000 tons, or but one-third of that used in this great pyramid, and that all of the earth which was moved to construct the 360 miles of that canal, or for the 500 miles of the Erie railway, or even for the 2,000 miles of the Pacific railway, each of them only equaled in quantity, that which was probably used, in the place of scaffolding, to hoist and lay the stone of this pyramid. Herodotus says that 100,000 men were engaged for ten years in building this earthen causeway, and that the same number of men were engaged for twenty years longer in laying up the masonry. My own calculations show that these statements cannot be far wrong, and you will observe that they do not include the workmen who were employed in quarrying, cutting, and transporting the stone, &c., which would have quadrupled the number. This great work required the labor of 500,000 men for thirty years, and at the present value of such labor in such countries, would have cost $5,000,000,000. A modern engineer would construct such a work for $100.000,000, and with a tithe of the men. He would quarry the stone by steam drills, load them with steam cranes, transport them on the Nile with steam-vessels, and on land with locomotives. Instead of 50,000,000 tons of earthen embankments, costing $10,000,000, he would apply a few hoisting machines, and with a score or two of men, would deliver the stone to the hands of the masons, as fast as they could lay them. I will give one other example and comparison with ancient engineering. The Amphitheater or Coliseum of Rome was finished in the golden period of the profession, in the year 79. It was an oval, and enclosed and covered an area of six acres. The structure weighed half a million of tons, and could seat 70,000 persons. The contrast with this building may be made by referring to the exhibition buildings of London and Paris. The London building was 1,848 feet long, and 450 feet wide, and sixty-one

feet high to the dome roof. The area of the ground floor was 773,000 square feet, or eighteen acres, being three times that of the Coliseum, and of the galleries 217,000, and of the glass 900,000. There was 3,500 tons of wrought iron, and 400 tons of cast iron used in its construction. It was built in nine months with the labor of about 2,000 men. The Paris building was an oval of 1,550 and 1,250 feet diameter, the outer court being 110 feet wide and eighty-two feet high, equivalent to a room 4,400 feet long, and 110 feet wide, or thirty-one acres area. There are three Egyptian obelisks in Rome, brought there by Augustus and Caligula. The largest being the one now in front of St. Peter's, weighs 275 tons, and the vessel which brought it from Egypt was the largest which had, up to that time, "ever been seen upon the sea." It is said when the engineer, Fontana, moved one of these columns to the Plazza del Popolo, in 1589, when it had been raised nearly to its poise, he found that the rope lashings had stretched so much that the main fall came "block to block," and it was impossible to fleet without lowering the column to the ground. While he and his associates were discussing how they could gain but one inch more, an old sailor came along, and as soon as he was told of the difficulty, sang out, "Why don't you wet the lashings, you lubbers?" The engineer took the hint, wet the ropes, which shrank enough to carry the column over the poise, and saved weeks of dangerous labor. Almost the same thing occurred in my practice. One of the long iron piles which I was driving into the bed of the Harlem had lurched a foot out of line. The most powerful purchases that I could rig would not move it. A sailor, in passing, said: "Make all fast, and wet your falls." This was done, and accomplished the result. While upon this subject of transporting great weights, I beg to call your attention to some of those moved in modern time. The largest stone in any erection in the world is the granite base of the column of Peter the Great, at St. Petersburg, which weighs 3,000,000 pounds, or one-fifth more than the largest stone at Baalbec. It was transported fifteen miles by land on a wooden tramway, with cannon balls for rollers. I have already mentioned the transport of the column of Luxor, and I might have added that it rests upon a single block of granite of 120 tons, brought from Britany sixty miles by land. There is a stone, the tazza, in the Treasury building at Washington, which weighed, when quarried, 300 tons, and, after being roughly worked down to 100 tons, was transported by sea 600 miles. And another,

in the same building, a buttress-cap, of the same quarry weight, which was roughed off to eighty tons before shipment, and, as now finished, weighs sixty tons. The Great Eastern steamship was launched sideways, being forced a thousand feet by very powerful machinery. At this time she weighed upward of 10,000 tons. The four tubes of the Britannia bridge each weighed 1,500 tons, and were launched, transported a mile through a strong tideway, and then elevated 100 feet perpendicularly. But we have only to refer to the "house moving" of recent times, when a large brick building has been moved a considerable distance; or to more recent ones, when whole blocks of large fine cut stone buildings in Chicago have been elevated ten or fifteen feet, without disturbing the occupants in their regular avocations; and at the present time, when all of the houses on 130 acres of a compact part of Boston are being raised thirteen feet; and also at Sacramento, where the whole city is being raised about fifteen feet. It may be interesting to compare the dimensions and tonnage of some of the largest vessels of former times with those of the present. The Ark was 450 feet long, seventy-five feet wide, and forty-five feet high, and if its displacement corresponded with the modern form of large vessels, its tonnage was from 12,000 to 15,000. "Show" ships were built by Hiero and the Ptolemies of from 560 to 590 feet long, from sixty to seventy-six feet wide, and eighty to 100 feet high. These vessels never went to sea, and could only be maneuvered in calm water. They were manned by 4,000 rowers, 400 sailors, and 2,850 fighting men. Their tonnage was less than that of the Ark. The Great Eastern is 695 feet long, eighty-two feet beam, and fifty-six feet deep, and a tonnage of 22,500. Her hull, engines, &c., weigh 12,000 tons, and she has a carrying capacity of 8,000 tons of freight, and 4,000 passengers, or she could transport 10,000 troops with all their munitions. There are some modern men-of-war of nearly 9,000 tons displacement. The Cunard and American sea steamers, those on the Sound and Hudson river, and even on the Mississippi, range from 3,000 to 5,000 tons. The largest steam engines in the world were those used for draining Harlem Mere. The steam cylinders were twelve feet diameter and fifteen feet stroke, and each one of the three engines drove eight water pumps of sixty-three and seventy-three inches diameter, and ten feet stroke. They were employed for seven years in pumping the water out of the lake to a depth of sixteen feet below the level of the sea, from an area of 56,000 acres, or twice that of Manhattan Island, which involved the

removal of 800,000,000 tons of water. Each of these engines were capable of delivering 200,000,000 gallons of water per day, and when the three engines worked together would discharge a volume six times as great as that which the Croton Aqueduct is capable of delivering. The next largest pumps in the world are those at the United States Dry Dock at Brooklyn (which are sixty-three inches diameter, and ten feet stroke), and capable of delivering 30,000,000 gallons of water per day, from a depth nearly three times as great as that of the Harlem Mere. The steam engines next in size to those at Harlem are those of the Bristol and Providence steamers, with cylinders of nine feet two inches diameter, and twelve stroke. A new pumping engine in London and one in Cincinnati have also cylinders of this size. One of the greatest of modern discoveries is the process of converting great masses of pig or cast iron into steel, in twenty minutes, without the aid of fuel or furnace, at a cost of half a cent a pound, and developing a heat heretofore unknown or unused in the arts, and a light equal to the combined effect of all the gas-burners in the city of New York. When it is remembered, that by the ordinary process, it requires several hours to decarbonize cast-iron and render it malleable, and then a fortnight to recharge it with the small quantity of carbon to convert into steel and another smelting, to produce cast-steel, thereby increasing the cost of the product four-fold, you will see the extent of the changes which this discovery is destined to introduce in engineering structures. Steel of more than twice the strength of wrought iron will soon be furnished at almost the same price. Already we have witnessed the commencement of this revolution in the substitution of steel for iron rails upon all our leading railways. Apprehensions have been expressed that steel which unusually is considered so brittle, will not withstand the heavy shocks of the locomotives in our severely cold climate. But I can say, from my own experiments and examinations here and abroad, that steel rails, properly made, are really very much tougher and much less liable to break in extreme cold weather than those made of the best of wrought iron. In fact, by this new process the rails are necessarily made of the exact degree of hardness and toughness that is demanded, and the English engineer now prescribes the extent of the carbonization of the iron, with a limit of variation of only one-tenth of one per cent. The tires of locomotives, the axles of cars, the large rods of steam engines, large and small shaftings, and many other of the most important parts of machinery are now made of this metal,

and we shall soon find it in common use wherever strength or security is demanded. The Seven Wonders of the ancient world were: 1. The Egyptian Pyramids. 2. The Mausoleum of Artemisia. 3. The Temple of Diana at Ephesus. 4. The walls and hanging gardens at Babylon. 5. The Colossus at Rhodes. 6. The statue of Jupiter Olympus; and, 7. The Pharos of Alexandria. If seven were popularly selected from the works executed in our day, they would be: 1. The Thames Tunnel. 2. The Great Eastern steamship. 3. The Atlantic Cable. 4. The Britannia and Niagara Bridges. 5. The Erie Canal. 6. The modern Ordnance; and, 7. The Pacific Railway. If the engineer was called upon to name works in which the highest degree of professional skill has been exhibited, he would probably make some changes in this list.

BRIDGES.

Probably few of the audience are aware of the hours of thought and study which are required of the engineer in the calculations and preparation of the plans for an important public work. For an illustration of this I will refer to the Britannia Bridge and Robert Stephenson. Mr. Stephenson began his investigation as follows: There are but three kinds of bridges—1. The arch, depending wholly upon the compression of its own materials; 2. The suspension, depending wholly upon the tensile strength of its cables; and, 3. The girder, in which some of its members are subjected to strains of compression, and some of them to tension. Bridges are often built combining two of these principles, but the difficulty of producing unity of action between them has led engineers to generally confine themselves to but one of them. Mr. Stephenson's first design was a bridge with arches of cast iron, of 450 feet span and fifty feet rise, with the center placed at an elevation of 100 feet above the level of the sea channel which they spanned. But the Admiralty, which had the legal control over such structures, declared that "no bridge should be erected which did not leave a clear headway of 100 feet for the *whole* width of the channel." The design of this bridge has been greatly admired, and many regrets have been expressed that the structure was not allowed to be built upon that plan. Mr. Stephenson's next design was a suspension bridge, with a stiffened platform; but the difficulty of combining two such opposite principles in the same structure, led him to dismiss the system of suspension as a permanent support, and his next design

was a girder, merely using suspension chains instead of scaffolding. Our own engineer, Roebling, the Pontifix Maximus of modern engineering, has practically demonstrated that these two principles may be usefully, safely and economically combined, and has applied them to spans of more than twice those of the Britannia bridge, and is also prepared to undertake those of four times that span. Unprofessional persons will better understand the difficulty of constructing bridges of long span when it is stated that the strains increase with the length of the spans. That is, that a bridge of 200 feet must be twice as strong as one of 100 feet; that the Niagara bridge is subjected to strains twice as great as those of the Britannia; and that the proposed bridge from New York to Brooklyn must be twice as strong as that at Niagara. Having determined upon the girder, Mr. Stephenson next proceeded to consider its proportions. A green willow wand, if laid upon two supports, not too far apart, will show the bark with a smooth surface on all sides. Now, if a weight be suspended from the middle, and the wand bent downward, it will be noticed that the bark upon the upper side is wrinkled up, and on the lower side that it is stretched out. The first is the result of compression, and the second that of tension. That is, all of the fibers of the bark on the upper side are forced together, and those on the lower side are drawn out. It will also be observed that about midway in the depth the bark remains smooth, not having been affected by either compression or tension. This is called the neutral axis, and this part of the stick is not subjected to any strain except to hold the upper and lower parts together. If a hole is bored out of the middle of the stick, it will be found that so far from weakening, it has given it the power to sustain as much more weight as that removed. Reasoning in this manner, the engineer determined to make experiments to ascertain how much of the interior he could remove with advantage. His first trial was with a cylindrical hollow beam of wrought iron, heavily plated on the top and bottom; and as these yielded first, he kept on strengthening them. Meanwhile he had gradually changed the form of his tube, from circular to elliptic, and finally to a rectangular shape, which his experiments determined as the best form. He spent a year or more in these experiments, aided by Fairbairn, one of the best mechanicians of the day, and Hodgkinson, a distinguished scientist, by means of which the best form and proportions of the different parts of the girder were determined from a model of forty feet length. Other experiments were made to determine the strength

of the riveting, of the lateral strength of the beam against gales of wind, of the strength of the stone and brick upon which the girders, &c., of 8,000 tons were to rest, all of which experiments cost upward of $50,000; but they enabled the engineer to lay down his plans with great certainty, saving on the one hand any unnecessary weight of metal in any part of the tube, and on the other from the weakness of some part, which would have lessened the strength and value of the whole structure. Before a blow had been struck upon this work, the engineer had completed his plans so perfectly that he had even marked out the position and size of every rivet in the tubes. Many volumes have been written descriptive of this work, which have been translated into the language of every civilized nation. It is true that the engineer would not now duplicate such a girder, but a quarter of a century ago it was the boldest engineering work of its kind.

Great Engineering Projects.

I will close this address with a reference to some of the great engineering works which have been projected in our day. In a recent paper, emanating from a board of distinguished engineers, they remark as follows: "There is danger that under the incentives of these wonderful achievements the engineer may be led either to attempt impossibilities, or what is more likely, to venture too far into an untried field of labor," and they add, "He (the engineer) would fail in his duty, and in a proper comprehension of his mission, if he allowed himself to project plans merely for his own personal eclat or aggrandizement, or if he did not confine himself to the most safe, practicable, and reasonable methods of accomplishing the results which are demanded of him." These conservative opinions, intended for the cautious capitalist, were doubtless those of a large proportion of the members of that convention, but among the engineers then present were some, who had themselves left the routine rules of the profession and demonstrated the possibility of plans which had previously been questioned. When we use the word "impossible," it as often indicates that our knowledge or reasoning faculties are insufficient to grasp the subject presented, as that the subject itself is in conflict with the laws of nature. Not very long ago it would have been hazardous to have advocated steam navigation, railway locomotion, or electric telegraphy. While Dr. Lardner was lecturing against the possibility of a vessel being able to cross the Atlantic by steam, the Sirius and Great Western steamers were on their first voyage from England to

America. While the most eminent engineers were building railways to be operated by horses and stationary engines, Stephenson produced the Rocket locomotive, and while the world was ridiculing Morse, the leaders of the Presidential Convention at Baltimore were conversing with the candidates in Washington; through the telegraphic wires. Among the great projects of the age are those for building canals, railways, bridges, tunnels, and steamers. It would be both presumptuous and hazardous so designate which of these projects are practical and which are chimerical, but those of each class which are most feasible I will name in order. In canal work we have a project for one around the falls of Niagara; again, an enlarged canal between the interior lakes and the Hudson, suitable for vessels of a 1,000 tons; the Suez canal (a rebuild of the one made by Necho, 610 B. C.); a canal across the Alleganies, between the navigable waters of the Ohio and James rivers; a canal through the Nicaragua lakes, or across the Isthmus of Panama, and one from lake Huron to Ontario. In railways, we have the Pacific, on the eve of completion; the Mount Cenis in rapid progress, the one across the South American continent, from Rio Janeiro, begun, and others of magnitude and numbers too numerous to mention. Of bridges, we have those in progress across our great western rivers; one proposed over the East river at New York, of 1,600 feet clear span; two over the Hudson, above and below West Point; another across the Straits of Messina, covering the "Scylla and Charybdis," with clear spans of 1,000 meters, or nearly two-thirds of a mile each, and with piers of 700 feet high, half below and half above water; and finally, the modern "Pons Asinorum," a bridge project across the Straits of Dover, sixteen miles long, in clear spans of two miles, with piers of 1,000 feet or more in depth. In tunnels, we have that of Mount Cenis, nine miles, and the Hoosic of five miles in length, both in rapid progress; one of wrought iron tubes (a sub-aquean bridge) under the Thames, and another under the Chicago river, almost completed; tunnels also proposed under the East and Hudson rivers at New York, under the Ganges at Calcutta, and under the Straits of Dover. After the annual dinner of the Smeatonian society in London, two years ago, this subject (the tunnel under the Straits of Dover) was discussed, and the chairman called for my opinion, remarking that my countrymen were noted for projecting (and accomplishing, he added) some of the boldest engineering schemes, and said: "Do you regard the tunneling of the Channel a feasible

project?" It being a post-prandial discussion, I felt at liberty to reply as follows: "Our late Chief Magistrate (Mr. Lincoln), as you know, had a happy faculty of expressing his opinion by an illustrative story, and with such high national authority, I will adopt the same method of answering your question. During the Peninsular war, an officer of Wellington's army, on his march to attack a strong fortress in Spain, was met by a brother officer, who naturally inquired the object of the movement. "What?" said he, "To capture (so and so), why man it is impossible." "Impossible?" repeated his friend, "not at all, for I have the *Duke's* order in my pocket." And so with the modern engineer, with the *banker's* order in his pocket, he considers almost *nothing* as impossible.

Mr. Greeley presented the following resolutions, which were unanimously adopted by the meeting:

In view of the entertainment and instruction afforded by the course of scientific lectures which has been closed this evening,

Resolved, That the thanks of the audience are hereby tendered to the American Institute and the scientific gentleman for the highly instructive entertainments thus provided.

Resolved, That the American Institute be requested to have this course of lectures published in book form.

PROCEEDINGS OF THE FARMERS' CLUB.

Rules and Regulations of the Farmers' Club of the American Institute, Adopted by the Committee on Agriculture, February, 1868.

1. Any person may become a member and take part in proceedings, by conforming to its rules.

2. The officers shall be a President and Secretary, to be chosen by the committee, in April, and hold for one year, and until successors are chosen or appointed. In absence of President, a chairman *pro tem.* shall be chosen by the Club.

3. Any member, for disorderly conduct, may be expelled by vote of a majority present.

4. The Secretary shall keep the minutes of the Club and have control of the same.

5. The President may at any time call a person to order and require him to discontinue his remarks.

6. The meetings of the Club shall be held every Tuesday, at one o'clock P. M., and continue for two hours, unless otherwise determined.

7. Discussion shall be confined to agriculture, horticulture, pomology, and subjects connected therewith and what relates to rural improvement.

8. All members of committees shall, so far as practicable, be members of the American Institute.

9. Questions or inquiries shall be made through the chair, but answers must be brief, and not lead to debate.

10. Any person desiring to speak shall rise and address the chair, and avoid personalities, and confine his remarks to the subject before the meeting; and the vote of any person may be challenged, unless a member of the American Institute.

11. No person shall speak more than twice on the same subject, or occupy more than ten minutes, unless by consent of the meeting.

12. Particular subjects may be fixed upon for any meeting, and in that case, shall be taken up for consideration at two o'clock.

13. The usual parliamentary rules shall govern when not provided for by these rules.

Members of the American Institute are members of the Club.

May 5, 1868.

The regular session of the Club was held on Tuesday afternoon, at one o'clock. In the absence of the permanent chairman, Professor S. D. Tillman called the meeting to order; Mr. John W. Chambers, permanent Secretary.

Seedling Apple Trees.

Mr. G. J. Knight, Brownville.—I have planted three orchards with seedling trees. One-half of these bore good fruit, some of which was very superior. The inferior I grafted, but they were not equal to the seedlings, nor so hardy. I am satisfied if Mr. Peterson plants good apple seeds he will have fine fruit, though it may not prove the variety he plants. The seed should be put in a box of moist earth, and left where it will freeze and thaw. It is important that they should be secure from mice.

Mr. A. S. Fuller.—I would not advise a man to plant seedlings any more than I would that he travel by stage-coach in these days of railroading.

Mr. Wm. Lawton.—A man may raise half-a-dozen good varieties in a life-time. I advise those who do not understand propagating trees to buy of well-known dealers.

Dr. Snodgrass.—We should encourage young men to make experiments. When seedlings were grown, trees bore well, and the fruit was good. If I see an old man planting fruit trees, it is good evidence he will live ten or fifteen years longer.

Dr. I. P. Trimble.—I approve of planting for experiment. By this means all our fine varieties have been obtained.

Dr. Hallock inquired which are the hardiest evergreen shrubs?

Mr. A. S. Fuller.—The American Holly, Rhododendron, Dwarf Juniper, Maximum, American Yew, Andromeda Cassandra, and the Floribunda are among the best varieties of hardy shrubs.

Transplanting young Maples.

Mr. Geo. H. Stilson, of North Carolina, says woods in his vicinity are full of young maples, not more than six inches high. He would know whether they would survive transportation by mail to Iowa.

Mr. A. S. Fuller.—Yes, they can be carried long distances by wrapping the root with a matting of soft, wet moss, and covering that with oilcloth.

RAISE YOUR OWN GARDEN SEEDS.

G. J. Knight.—Now is the time to prepare for saving seeds, and a little attention will save many dollars; besides, one is certain of having pure seed. Some persons set out cabbage stalks. I prefer medium-sized heads. Prof. Mapes said farmers' seeds deteriorate; this may be through improper cultivation. In my experience our vegetables have improved. Care should be taken to select the best and earliest peas, beans, squashes, cucumbers, and corn for seed.

COAL ASHES.

Mr. Jacob R. Kimble, Vestal, N. Y.—In what way can I use coal ashes best?

Mr. Solon Robinson.—Let him sow them on his grass lands. They will do more good there than on plowed ground. Coal ashes have less potash in them than wood ashes, but they have a good deal of silex in a fine state, and this is useful for grass especially; also for oat straw. But they have but little effect on grain of any kind. They are useful as an absorbent of bad smells, and on that account can be used to advantage around a sink or cess-pool.

Mr. A. S. Fuller.—With me, coal ashes are worth three dollars or four dollars a load, especially on sandy soil.

SHAVINGS ON WET LAND.

Mr. E. Howe, Speedville, N. Y.—Are pine or basswood shavings good for wet land when plowed under?

Mr. Solon Robinson.—He had better burn them and use the ashes as manure. They are of little use as shavings, unless first used about yards and stables, and thoroughly saturated with some fertilizing fluid.

CATERPILLARS.

The commander of the military post at Detroit wanted to know how to destroy tree caterpillars.

Dr. I. P. Trimble.—The cedar birds, killed in great numbers and sold in our markets, are most active and industrious friends to the farmer, eating many of the worms and bugs that prey upon his fruits. Many of our worst enemies, as the canker worm, suddenly disappear. It is found that another little insect, a parasite, comes along and lays his egg in the egg of the canker worm and thus kills it

Dissolving Bones.

Mr. J. B. Lyman.—The cheapest and easiest way I found was to take a deep box, barrel, or hogshead, the latter I like the best; cover the bottom about two inches deep with ashes and lime mixed, about one part lime to two of ashes; the lime should be newly slacked and mixed with the ashes, both dry; then put in a layer of bones, then two or three inches of the lime and ashes again. Fill up in this way to about eight inches of the top; then fill out with clear ashes, or the compound, and then wet it gradually until it is thoroughly saturated, but not so as to drain; let it stand at least six months, the longer the better. When wanted for use take it out, fork it over and pick out all the bones that are not soft, and save them for the next batch, and then pulverize and mix the ingredients well together, and you will find it one of the strongest and best fertilizers in use.

The Curculio.

Mr. J. B. Lyman said he had a correspondent in Middlebury, Vermont, H. A. Sheldon, to whose opinion he attaches a high value, because he never advances a theory unless sustained by an array of facts. He is at once a chemist and a farmer, and conducts agricultural experiments, the result of which he communicates to the world. He sends the following experiment, which is at least worth remembering. Dr. Trimble's opinion is especially solicited.

Five years in succession my plum trees blossomed beautifully, and for five years the fruit was destroyed by the curculio, so effectually that I did not obtain one dozen plums. Becoming somewhat desperate, I resolved to head off the Turks or destroy the trees. I had just emptied a barrel of gas-tar. This I filled with water, which in two days was dark colored as coffee, and pungent as creosote. On the first appearance of the curculio, with a small hand forcing-pump (which every gardener should have), I gave the trees an effectual drenching, and repeated it every three days for two weeks, but did not find a plum stung after the first application. To my extreme satisfaction, there was such an abundance of fruit that it was necessary to place supports under the limbs to save the trees.

Dr. Isaac P. Trimble.—I am glad this letter has been received, and is a complete experiment, with one exception, which, perhaps, Mr. Sheldon will supply. I would like to know whether his neighbors who used no coal tar water had plums that year? When it is dry the egg of the curculio will not hatch. It may be the season and not

the application that gave Mr. S. his plums. For my part, I have long regarded the curculio as a pest within control of the farmer and fruit-grower. The remedy is for everybody to destroy all apples, plums, and other fruit that fall to the ground on account of the curculio sting.

Mr. Solon Robinson.—For my part, I am obliged to the gentleman from Vermont who has sent us this recipe, and I thank the gentleman who has read it to the Club. I shall try it, for the acids that come from coal tar are known to be the best we have for the protection of our orchards. As to Dr. Trimble's idea that hogs can rid us of curculio, I reject it. The hogs are worse than the curculio.

Dr. I. P. Trimble.—I had no idea of imposing my opinions on the Club. I was appealed to for my view, and I gave it. The hog remedy has been tried and found to work. The farmers of Western New York know of it and have used it. The result is they give us all the apples we have, and are getting rich in the fruit business.

CLARIFYING OF SORGHUM SYRUP.

Mr. Clough, of Cincinnati, Ohio.—Sorghum has become a great and a permanent interest in the West. In 1866 its production amounted to 35,000,000 of gallons. This was slightly in excess of the immediate local demand, and in the year following, last year, considerably less was planted. Now the surplus of 1866, together with the product of 1867, is nearly exhausted, and sorghum at the present time commands a higher price and is in greater demand than ever before since its introduction into the country. This year it will be very generally and extensively cultivated. The product of sorghum is from 100 to 200 gallons to the acre. Land that will produce fifty bushels of corn will produce at least 150 gallons of sorghum. The fee or toll charged by farmers for manufacturing syrup for their neighbors is one-third of the product, so that the grower who has his syrup manufactured "on the shares" realizes at the rate of two gallons of syrup from the same land, and we may also say, for about the same outlay in labor that would produce one bushel of corn; thus when two gallons of syrup will sell for more than a bushel of corn, cane is the most profitable crop. At present the price of syrup per single gallon is more than the price of corn per bushel, and this is generally the case.

Sorghum has not heretofore been cultivated as a commercial crop. It is mostly consumed in the obscure homes and hamlets where it is

produced. Here the quantity used is surprising. In answer to a circular addressed to several thousand producers, I learned that the average quantity consumed in families of six persons, where the syrup is used as freely as other common products of the farm, is from fifty to one hundred gallons per annum. A great portion of the answers reported two barrels or eighty gallons. This illustrates the usefulness in the human system of sorghum, and it proves that it is a wholesome aliment, otherwise we should have some indications of rebellion from that sensitive member of the corporeal union. The truth is sorghum is a boon, to all that broad belt of country in which it can be grown, of incalculable value. America, and particularly young America, has a sweet tooth. Childhood clamors for sweets. But sugar in all its commercial forms is expensive. It must be paid for with money; hence the great mass of farmers must use it sparingly. Here, however, is a sweet which can be produced at home, without any outlay, except a little extra labor, and which can be indulged in without stint. We now propose to produce sorghum for commerce, and allow the cities and towns to enjoy it with us. But there is an odor and flavor about crude sorghum which town people and those not familiar with it dislike, and we who have been raised upon it, and who consume two barrels a year think we might worry down a little more if the quality were considerably improved. Moreover, there is a want of uniformity in the quality which makes it very inconvenient for merchants to deal in it. We propose to remedy all this by the new process of refining and deodorizing sorghum which I am to exhibit and explain. By this process, which can be managed by any ordinary farmer, and which requires but a trifling outlay for apparatus and materials, refined sorghum syrup can be made directly from the juice, *nearly* as good as the best sugar-house syrup produced by bone-coal filters, vacuum pans, and all the intricate and expensive appliances of a regular sugar refinery. Before proceeding with the operation of refining, I will explain the process, that you may understand the nature of the reactions which will be observed. The materials used are, first, the insoluble earthy sulphate of baryta; second, a highly silicious silicate of soda (the alkaline commercial silicates are not appropriate), and lastly common lime. The materials are added to the juice or diluted syrup, and brought to the boiling point. At the boiling point, the silica unites with the earthy salts which hold the albuminous matter in solution, and with them and the added lime, forms a complete

coagulum, locking up all the suspended impurities, carrying all to the bottom, leaving the liquid, as will be seen, perfectly clear and transparent; as clear as wine. The clear liquid may then be poured or drawn off and boiled to the proper consistency, producing a perfectly refined and pleasant flavored syrup. The peculiar odor and taste of sorghum being totally removed, as will be seen by a comparison of this crude sorghum and a portion of the same which I will now refine and submit to you. This which I have explained and which you will now see constitutes the whole process. It can be performed here over this gas stove with a gill of syrup, or in the farmer's kitchen, or country sugar camp, or in the commercial refinery upon a scale of any required magnitude.

In continuation of the subject, Mr. J. A. Allen read a letter from Ohio, giving an account of sorgo sugar made by a Mr. Watson, by a combination of shelves over which the syrup passes. The mode is called Spencer's process. It makes from five to eight pounds to the gallon, and operates as well on green cane syrup as on that which is ripe. The room or chamber in which the syrup is thus treated is heated to the temperature of one hundred degrees. Mr. Clough doubted whether good sugar would ever be made from sorgo.

Mr. Solon Robinson.—I am glad of this lecture on a subject of great importance. But why should we attempt to grow sugar on our rich lands when in Florida and Louisiana land that is worth a dollar an acre, and will produce but seventeen bushels of corn, will yield 2,000 pounds of sugar. Sorgo will never compete with a tropical sugar cane.

Mr. J. B. Lyman inquired of Mr. Clough as to the length of the season required for maturing sorgo, and whether it can be recommended to farmers north of New York city. Mr. C. is of opinion that it pays better than corn in Connecticut. In Ohio it is but from the middle to the last of September. It will prove a paying crop wherever there are four months wholly free from frost.

KNIFFEN MOWER.

The Kniffen mower was exhibited by an elegant little working model. It differs from the Wood, Buckeye and others, in the cam that operates the knives. This is so geared that no matter in what direction the finger bar is moved, the knives keep on just the same. Hence it appears to be superior to the other mowers for side hills and rough land.

The Sancho Pancha Wind Mill,

Exhibited by Mr. J. D. West, of this city, for operating a pump, was also shown by a large model. Its peculiarity is in a weight connected with the braces of the fans in such a way that a strong wind turns their edge on so as to present no surface. In this respect it is self-regulating. Its main use is for lifting water to the tops of houses, barns and factories. It costs about $100.

Prof. Tillman thought the self-adjusting boxes a valuable improvement on the ordinary windmill.

Report of the Committee on the National Corn Husker.

The committee, consisting of S. Edwards Todd, chairman, J. B. Lyman, W. S. Carpenter, A. B. Crandall, John Crane, and R. Meeker, appointed by the club to examine the national corn-husking machine, desire to submit the following report: This corn husker may be driven by horse power, or turned by one or two men. The corn-stalks, with the ears attached, are fed with the rollers, six or more at once, just as stalks are fed into a fodder cutter, butt end first. The ears, with a part of the husks, drop down in a hopper, and pass sideways over a system of iron rollers, which seize the husks and silk, and strip the ears as neatly as it can be done by hand, at the rate of one bushel per minute. Heretofore, corn huskers have been provided with India rubber rollers, or husking aprons, which did not always operate as satisfactorily as the present machine, which latter is made of iron and wood, with only India rubber bearings. The committee saw this machine husk an ear neatly, while the husks, at the tip end, were tied on with a strong cord. If every alternate ear were a small nubbin between large ears, twenty inches long, every husk will be neatly removed.

The committee found this national husker a valuable labor-saving machine, as durable as a threshing machine, and not liable to be deranged in any of its parts, by the carelessness of unskilled laborers.

"An important point of transcendent importance in the operation of this husker is, that it separates and assorts the bright and most valuable husks from the weather-beaten and worthless ones, the former being delivered beneath the machine, and the latter carried between the rollers with the stalks, to which they are still attached. As the stalks pass between the rollers, numerous gashes are cut in one side of the larger butts, which, together with the crushing of those parts that are filled with sap and water, greatly facili-

tates the curing and drying of the fodder. After the large butts of corn stalks have been crushed, they will become sufficiently dry to stack in a few days, whereas, if they are not crushed, several weeks will be required to dry out the large stalks.

"In conclusion, your committee feel themselves quite justified by the remarkable value of this invention, in speaking of it in terms of the highest recommendation. A great drawback and discouragement in raising large crops of Indian corn has been the amount of heavy and monotonous work required in stacking, husking, and housing the stalks. This machine wholly masters the difficulty. One day's active running of the national husker will, as we are convinced from the performances we saw, turn out five hundred bushels of ears and two corresponding piles—one of stalks and outside husks, the other of clean inside husks. The gearing and other parts of this machine are simple and strong in their make, not easily broken, nor soon worn out. The bearings, instead of being immovable, are fitted with pads of gutta percha, so as to yield to the pressure of foreign substances that might get into the machine. We are disposed to class this invention in the very first rank of those numerous combinations of which American genius has been singularly fertile, the object of which is to harvest our enormous crops of the great cereals."

The report was accepted without dissent.

MAPLE TREES.

Mr. James Lobdell, Longedy, Sullivan county, N. Y.—I thought I would try an experiment on three trees to see how much they would make, and I got sixteen pounds of sugar and two quarts of molasses. I think ten pounds might be made from a tree eighteen inches through. I lost half the run of the three trees, being unwell, for I have had the rheumatism for fifteen years, and have had to go on crutches. There is a difference in the sap and flavor of different trees, as well as in quality. God has planted this tree for the use of man, to show his great power and infinite wisdom. And now how do men use it? Not so much as the Virginia wood-peckers, for they peck in, and if the sap suits them they tap the tree so much they kill it. Some people here tap 200 trees and get 200 pounds of sugar, and think they do well, but I think they ought to get 2,000 pounds. I think the trees could be set when young for fence posts, say three to a rod. I would sell thousands at a cent each, if folks would come and get them. If I was young and had a farm and did not have these trees, I would

have them quick, and set them along the road where they are easy to get to, and they are sweet and full of molasses and sugar. God has made some of them very sweet, and we may learn how to get it out by the sweat of the brow. But lazy folks never can; they try some other way, generally they want somebody else to do it. I would say to the club speak loud and plain.

Influence of the Hive upon Successful Bee-keeping.

Mr. Jasper Hazen, Albany, N. Y.—1. A hive of 2,000 cubic inches, and no boxes, will give no surplus honey in good shape for market.

2. A hive with boxes upon the top, of the capacity of twenty pounds, may give from nothing to forty pounds.

3. A hive with boxes of the capacity of seventy pounds, upon the top and sides, will give twice or thrice as much surplus as the second class named.

4. A hive with boxes upon the top and sides, of the capacity of 125 pounds will give twice as much surplus as the third class named.

Demonstration.

In 1864 I had three of the second class of hives. They gave me each one swarm, and not one pound of surplus honey. With the other proprietors I had thirteen in the third class of hives. They gave 797 pounds of surplus, an average of sixty-one pounds. In 1867 I had eight colonies in the third class of hives, and four colonies in four Eureka hives, the fourth class. The eight gave 500 pounds of surplus, an average of sixty-two and one-half pounds; the four Eureka hives gave 500 pounds, an average of 125 pounds. I know no reason why the difference in the amount of surplus was not owing to the different construction and size of the hives. A productive queen will give working force sufficient to work in all the eighteen boxes at one time, so as to begin in the last before the first is fully completed. If, instead of the eighteen boxes, as furnished in the hive No. 4, they only have two, as given in No. 2, all the workers will cluster out in idleness, but the small number that occupy the two boxes.

Adjourned.

May 12*th*, 1868.

Mr. Nathan C. Ely in the chair, Mr. John W. Chambers, Secretary.

Black Knot.

Mr. Edward Taintor, Hartford, Courtland County, N. Y., wrote, substantiating his theory regarding the cause of black knot in fruit trees. He alluded to Mr. Fuller's remarks, and he requested him to prove his authorities that insects are not the cause of this disease.

Mr. Solon Robinson.—When I was a boy the musquetos bit me severely, and my hands were covered with warts, but that does not prove that musquetos were the cause of the warts.

Mr. A. S. Fuller.—Our scientific men declare that the black knot is a disease. I know very well that insects lay their eggs in these knots, yet I don't believe they produce them.

Dr. I. P. Trimble.—I have studied this subject for years, and have found both insects and eggs in the knots. I agree with the German writers, who say that the knots are produced by fungus.

Mr. Daniel H. Knapp thought they are caused by tight bark. By frequently making incisions or cuts at the proper time and place, he had no trouble with the black knot.

Mr. Wm. S. Carpenter.—A few years ago trees were not troubled. I find that thrifty trees scarcely suffer at all, and I am inclined to think the fungus is the most probable cause of this disease.

Mr. J. B. Lyman.—E. Dickson, Amherst, Mass., prevents this black knot by putting salt around the trees just before the last snow goes away.

Mr. H. B. Smith, Westfield, Mass.—I have no trouble with this disease except on trees in poor condition.

Dr. Jarvis recommended top pruning and good cultivation.

Removing Stumps.

Mr. D. L. Parish, Portville, N. Y.—Mr. C. Lanark wants to know how to get rid of stumps after they are pulled. In this county we plow and scrape a hole twenty-five feet long by fifteen feet wide, and about four feet deep, with the sides sloping, so that the stumps will roll together as they burn. They should season a few months before they are fired.

Concrete Houses.

Mr. Thomas Thompson, Scipio, Ohio.—I built one of these houses eight or nine years ago, and it proved a complete success. The chief

difficulty lies in not knowing the proper quantity of each material used. To four bushels of sand and gravel add one bushel of good stone lime, increase the amount of lime as it air-slackens, and mix enough of the compound to go once around the building. We completed a round once in forty-eight hours; some do it in twenty-four. We made our bed in the evening, and found the lime ready for mixing by morning. We put the mortar in molds, with as many small stones as we could beat in, thereby lessening the cost and strengthening the wall. Much depends upon the nearness of sand, gravel and stone. No danger need be feared from rain if the walls are covered with boards.

Horse Flesh for Food.

Mr. J. B. Lyman.—Mr. Chairman: We have with us to-day a gentleman who has earned for himself a rare and admirable distinction for his exertion in a much neglected department of justice and charity. Born in affluence, associated by family and education with the class who usually walk not on the dusty and thorny track of the reformer, but "in the primrose path of dalliance," he spent some twenty years of his life in the capitals of the old world. Returning to America, not stained by their vices, nor chilled by their selfishness, he saw that in our eager and strenuous activity, in the all-conquering push of our magnificent enterprise, we have been as a nation indifferent to the rights of the brute creation, and often unchristian, cruel, and ruthless in our treatment of these dumb servitors of the race. He organized a society for the prevention of cruelty to animals, of which he is to-day the president. That society feel, Mr. Chairman, and its president especially is penetrated with the conviction that much remains to be achieved. Abuses are to be corrected, some bad laws to be abolished, good ones to be enacted, and, above all, the public to be educated to a purer, a higher, and a juster humanity. I am, therefore, glad and proud of the opportunity I now have of introducing to the Farmers' Club, Mr. Henry Bergh.

Mr. Bergh.—Gentlemen of the Farmers' Club: I am not here to instruct you in the noble science of agriculture. Among the Romans, agriculture was held in great esteem. Cato, in the second, and Varro, in the first century before the Christian era, Virgil, at the time of the birth of our Saviour, Pliny, Columella, and Palladius, have all extolled its excellences. Several of the noble families of Rome derived their patronymics from some vegetable which they were

famous for raising, such as the Fabii, the Lentuli, and Cicerones. These were the days of Roman agricultural glory. Cato says: "When they praised a good man they called him an agriculturist and a husbandman; and it was deemed a great honor to be thus spoken of." Cincinnatus, who flourished 460 years before Christ, was the plowman of his own four acres; and when the Lamnite embassadors visited Curtius Dentatus, they found him at work among his vegetables. Cato says: "Study to have a large dunghill;" and to this I would add: Treat your dumb laborers as inferior brothers, deprived of speech. There are a number of topics to which I would call the attention of this club. The society, of which I have the honor to be the president, has of late offered, in connection with this club, a reward of $100 for some invention more suitable and painless to oxen than the yoke in common use. The mode of fastening by attaching the yoke to the horns of the oxen is open to a serious objection. In some parts of the country where flies abound, the animal is unable, by shaking his head, to rid himself of these annoyances. Where flies are not troublesome, this mode may be the best. As to the use of blinds on horses, is it not a practice that injures the sight of this noble animal, and does it not render him more timerous and dangerous than to allow him the full use of his organs of vision? Another suggestion: Why, for the sake of what we conceive to be a finer carriage of the head, do we so habitually chafe and torture our horses by the use of a check-rein? In Russia, where I passed many years of my life, such a thing is never used as a blind or a check-rein. Can we not also improve upon the material and form of the iron bit, so as not to lacerate the mouth and bruise the tongue, and particularly in winter, when the iron is intensely cold, consider the cruelty of putting into his mouth a piece of iron that will freeze and flay the tongue?

Modern art has made such advances in a knowledge of pain-killers that it would be easy to put in a state of insensibility those parts of an animal to which for any reason we have occasion to apply the knife. Is this ever done? Why are all so slow in introducing these obvious and natural humanities? I have observed, gentlemen, that you sometimes discuss the best wash for protecting your orchards from grubs and insects. Humanity to all the birds of the air is the best lotion. The wash costs nothing, the want of it, the wanton killing of birds by thoughtless boys and cruel men, is the reason why the black knot and the curculio have robbed us of millions of bushels

of delicious fruit. But of all the brute creation the horse is the most useful as well as the most faithful to man, and, with shame be it added, the most abused. Scarcely are the days of his infancy passed than the bones, the sinews, and muscles of which he is composed are brought into requisition, and from this time until his earthly career is run his existence becomes an uninterrupted contest with his natural enemy—man—and this for no other fault than serving him too well. A distinguished French moralist has said, "*de tous les etres de la creation, le plus cruel c'est l'homme.*" The most blood-thirsty and cruel beast slays his enemy with the dispatch which hate or hunger dictates, but it was reserved for that being which was fashioned after his divine master in form, civilized man, to employ the subtle elements of cultivated reason in augmenting the sufferings of his human foe and his dependent cattle. Prompted by this melancholy idiosyncracy of the race, societies have sprung up in Europe, in Asia, and Africa, and of late here in America, for the defense of that vast body of God's creation called—sometimes, I think, miscalled—the lower animals. If I may be allowed a short digression here, I would show this audience what in a mere pecuniary point of view is the value in the United States of these only five species of animals; or, in other words, to make the thoughtless and the cruel conscious of a fact of which they must be ignorant, that these five species of animals alone are of more productive value to the country than all the men and women in it. In short, I venture to assert that without them commerce, agriculture—nay, civilization itself—is impossible. In 1860 the domestic animals in the United States were 9,000,000 horses and mules, 29,000,000 neat cattle, 24,000,000 sheep, and 37,000,000 swine. Since 1850 they have increased as follows: Horses and mules had doubled in number, neat cattle had increased by one-half, sheep by one-tenth, swine by one-fifth. Their aggregate value was $1,000,000,000, having exactly doubled in the ten years from 1850. One-tenth of the whole valuation was owned in New York State alone. Their approximative annual revenue in 1860 was: Labor, exclusive of cost of feeding, &c., calculating 12,000,000 working horses, mules and yokes of oxen, and the labor of each at fifty cents a day for 300 working days only, would be $1,800,000,000 per annum; animals slaughtered for food, worth $250,000,000; butter, 460,000,000 lbs., worth $90,000,000; cheese, 100,000,000 lbs., worth $10,000,000; wool, 60,000,000 lbs., worth $24,000,000. I regret that I could not obtain the valuation of fowls,

which must have been proportionately large. The above gives a total revenue of over $2,000,000,000, almost as much as our existing national debt. Add to this the value of the animals, and we have in 1860 the enormous wealth of over $3,000,000,000. As an illustration of the increase from 1850 to 1860, the yield of wool in the Pacific States is most striking; in 1850 it was but 77,330 lbs., while in 1860 it was 4,000,000 lbs. This is one of many items that shows the increasing importance of our live stock. From these dates it appears, and they are official, that during the four years that the lords of creation were engaged killing, burning and outraging these States, the abused animals they were replenishing the fearful waste so far as they were able by money value exceeding annually the entire national debt. If we add to this the able and effective coöperation of our Southern brethren in that desolating strife, the disparity of which I spoke becomes the more apparent. Such, then, are creatures which the American Society for the Prevention of Cruelty to Animals is striving to defend from their worst enemy. Notwithstanding the astonishing apathy or reckless indifference to it, there is no subject affecting the temporal well-being which deserves as serious consideration as the mode of transporting cattle, destined for human food, to market. I venture to declare that not one person out of five thousand pauses to reflect on the probable health and general physical condition at the time of the death of the animal he is about to dine on. Were he to do so, or, what is still better, were he to journey to the West as far as Chicago, and after observing the cattle-yards there, and the manner of treating the helpless brute consigned to the care of beings wearing the form of men, but possessed by the instinct of devils, then take passage back to this city on a cattle train, and note the accumulating tortures heaped upon these inoffending prisoners, even to the moment when the unfeeling butcher murders what little of life remains in these feverish, bruised, maddened animals—were he to do this, I say, I hazard little in affirming that his appetite for such kinds of animal food would receive a shock not to be forgotten for the remainder of his days. From the confines of Texas even to the wharves of the metropolis are these creatures, the offspring, like ourselves, of Omnipotent Power, doomed to endure on foot the ceaseless motion of the train, deprived of food and water from four even to six days, as I have been informed, exposed to the blazing rays of the summer's sun and the freezing blasts of the winter's wind, with no spirit to care for them but the soul of stinted avarice. And yet, gentlemen, the

directors and owners of these mobile inquisitions, they that hold in their hands the power of affording to these poor wretches the nourishment which God and nature declare indispensable, wickedly and meanly trusting to chance or the power of animal endurance, day after day and year after year inflict these dreadful torments on uncomplaining brutes, and thus endanger not only the health but the moral and mental attributes of mankind. For what end? To add still greater luxuries to their already pampered existence. If there be any doubt on this subject, let the skeptic take passage, as three of the society's agents have done, and observe the fearful treatment inflicted on the helpless and submissive victims of mammon. Having done this, notice the brutal manner of overloading them in this city; the clubbing, the breaking of legs and horns! Go with such as can stand, to the cattle-yards where they are imprisoned, still deprived of food and water, left without shelter from either sun or storm. And finally, if you have the courage and then nerve to witness the last act in the barbarous tragedy, go to the shambles and look at the supreme and concluding torments which the monsters heap upon the creature, which the day following appears as food upon our tables. It is on account of the atrocities of this mode of supplying flesh to this city that I have of late been investigating the question which has so deeply interested the French nation. I refer to the propriety and wholesomeness of cooking the flesh of horses for food. In this, I know I meet a deep-seated prejudice. But the office of civilization is to conquer prejudice. Not long ago the eminent director of the Veterinary School at Alfort, Mr. Renault, gave a banquet to some of the leading physicians, directors, soldiers and journalists. Dishes of horse meat and of beef were arranged side by side upon the table, all cooked by the same *chef;* the former taken from a horse that had been killed because of paralysis of one of its limbs, the latter from a young steer. The testimony of those who partook was as follows: *First.* The soup of horse meat is superior both in respect of aroma and taste to that of beef. *Second.* The flesh of the horse boiled is firmer and more dry than that of the ox, and its flavor very agreeable. *Third.* Horse meat roasted is delicious, its smell resembles venison, to which it is not inferior. There must be a beginning of everything, and so a horse dinner has lately been served at one of the great hotels of London. A gentleman present thus speaks of it: "For my part I will simply say that horse flesh appears to me to be excellent food. I wish nothing better for dinner. It is fine in tex-

ture, tender in quality, and unimpeachable in flavor. Its resemblance to beef is remarkable. Without previous information it would be difficult to tell the difference between them. That there is anything disagreeable or unpalatable about it cannot be maintained for a moment." On reflection it must appear to everybody that the flesh of the horse must be as healthy and nutritive as that of the ox, since its component principles are the same, with an excess of creatine, a substance which, according to Leibig, acts an important part of the vital functions. In the city of Vienna, during the last three years, 4,726 horses have furnished over 1,000,000 pounds of meat, and the demand is continually on the increase. By a fair and sound estimate, which I need not detail here, it can be shown that 80,000,000 pounds of sound, available meat for consumption could be added to the annual food supply of the country could we but overcome the prejudice that we have been educated to feel on this subject. I regard this question, therefore, as one that relates directly to agriculture as well as general economy and public morals, by the merciful and humane withdrawal of those faithful creatures from service when no longer useful for labor, instead of abandoning them to a miserable and reproachful death.

Dr. J. C. V. Smith.—I cannot but recognize that this gentleman has taken a step for humanity in advance. We derive our views of horse flesh as food from the mosaic law, which declares all animals with uncleft hoof, and not chewing the cud, as unclean. It is the business of civilization to overcome prejudice. What Mr. Bergh said regarding the ox being enabled to protect his eye when the hard yoke is on him, need offer no difficulty against its use, for nature has provided an additional eye-lid, scientifically called *membrana nictitans*. By drawing this over the eye-ball, all dust and insects are at once removed.

Mr. Solon Robinson.—I thank Mr. Bergh for what he has done. This gentleman has gone through our streets, an apostle, preaching the gospel of mercy to every animal. I say all honor to Henry H. Bergh.

Upon a motion that the thanks of the club be voted, and a copy be requested, considerable discussion arose.

Mr. J. B. Lyman.—What is said of horse-flesh meats with deep seated prejudice which may not soon be overcome, but the afflicting recital of the brutality of the present system of beef supply deserves attention of all.

Mr. N. C. Meeker.—Of course every person here or elsewhere applauds the efforts and the success of the Society for the Prevention of Cruelty to Animals. But I feel that some protest should go from this club, or at least from some member, against the use of horse-flesh. We have more kinds of meat now than is for our good, and instead of seeking new sources we should rather diminish some of these we have. There is little doubt but the foundation of cruelty to animals in some degree had its origin in man, so hardening his heart as to be able to slaughter his dumb companion and to use its flesh for food. In seeking supplies of food let us rather enlarge our orchards, our fruit gardens and grain fields, and by so doing we enlarge our social, moral, and religious sentiments.

Dr. Isaac P. Trimble.—I should dislike to have the club in any way indorse the eating of horse flesh in connection with efforts for preventing cruelty to animals, and it seems to me that the move will be prejudicial to this benevolent society in which we are all so much interested.

Mr. Henry Bergh.—These views do not at all represent any other member of the society to which I belong than myself, and the remarks were made wholly on my own motion.

Prof. Gamgee, of the Albert Veterinary College, London.—What Mr. Bergh has said regarding the beef that comes to your market is doubtless true. I have found out why the people of this city eat their meat so nearly raw. The juices are lost by transportation. You can never get good flesh while it is shipped long distances. In reply to Mr. Meeker I would say that it has been shown, time and again, in Europe, that when you rob the people of flesh meat, pauperism and crime are produced. All energetic and progressive races use animal food.

The Chair.—I feel that if we fail to appreciate the work which Mr. Bergh has performed, the very animals, like Balaam's ass of old, will cry out against us.

Maple Sugar from Vermont.

Mr. O. S. Bliss handed around several fine specimens of maple sugar, which he manufactured after the usual manner.

Eureka Condensing Coffee Pot.

This claims to condense the steam and preserve the aroma. The construction is simple, and prevents all coffee grounds from escaping out of the coffee pot spout.

Mr. Chambers spoke highly of it, after using one for several months in his family.

The Chair also commended it as the best coffee pot he ever saw.

A New Road-Scraper.

Mr. Henry J. England, of Delhi, Delaware Co., N. Y., exhibited this, and it was universally commended by the Club, including Solon Robinson and Mr. Carpenter. It is so constructed that when the operator touches a spring it dumps itself and turns back again without the team having to be stopped. The improvement can be applied to ordinary iron-scrapers. Those who may want such an implement must know that none are for sale at present, as it is just invented.

Mice Girdled Trees.

Mr. J. D. Adams, Fleming, Cayuga Co., N. Y.—In reading your proceedings from time to time, I notice some things that I think have a tendency to mislead. For instance the statement in regard to trees that have been girdled. First: A mound of earth, if it succeeds at all, will be by causing the tree to make new roots from the bark at the top of the denuded surface, the original root will die in a short time, your tree will be feeble and worthless, it having been converted from a seedling to a layer. Second: To graft with strips of bark will be a total failure; but if you will cut away a portion of the wood so as to permit you to insert a stick or limb of considerable size in proportion to the tree girdled, in the same manner that you mention, you will succeed if the work is done early and well. We have a number of trees thus served, as also those of our neighbors, which we have done for them, and they have stood the test of years, and are now bearing sound pears. I send you this, well knowing how any one feels after planting and watching a tree for years, to have their hopes blasted under the cover of a snow drift.

Osage Orange.

Mr. H. Duman, Luton, Canada.—When is the seed planted; where can it be procured, and which is the cheapest, the plants at seven dollars a thousand, or the seed?

Mr. N. C. Meeker.—It is too late now to plant either. The seed can be had in our large seed stores, particularly west. A good seed-bed is made where the hedge is to stand, and the seed is sown as soon as the ground is warm in the spring, after being warmed or sprouted

in a sack or box. The price varies with each year. Plants can be had of Illinois nurserymen as low as three dollars, and it is cheaper generally to buy them than to raise from the seed.

FOWLS ROOSTING IN FRUIT TREES.

Mr. C. Renwick, Wolfborough, N. H.—The opinion prevails that to allow fowls to roost in a fruit tree will result in its final destruction. Is it on account of the amount or nature of the manure dropped, or for other reasons?

Mr. N. C. Meeker.—It is hard to tell what the cause may be, but nothing is more certain than that if a farmer allows his fowls no other place to roost than in his fruit trees, said trees will bear little or no fruit. More than this, his cattle are apt to die in the spring, and they are always lousy; his hogs are distressed, as can be told by their squealing; his boys have holes in their pantaloons, and are apt to chew tobacco, and his house, barn and fences are in bad order.

HAY TEDDER.

Mr. Wm. Langworthy, West Edmeston, Otsego county, N. Y.—I wish to learn something of the practical value of a hay tedder, the price, and where made? We have 100 acres of heavy grass.

Mr. N. C. Meeker.—Those who have used tedders like them, and the general testimony is that in wet seasons they will pay for themselves, for, as they will stir a large amount of hay rapidly, they really add to the duration of sunshine. As to where they are made, that is a conundrum. Only our advertising columns can solve it.

LEAD LANDS IN ILLINOIS.

Mr. H. Stevens, Dunleith.—Persons inquire concerning mining in the lead regions of Wisconsin, and Dubuque, Iowa. Good mineral lands can be leased here in the mining districts. Some are open for any one to prospect and mine on, by paying the usual ground rent. In wet or water diggings, the proceeds for the use of the ground are from one-ninth to one sixteenth, as parties may agree; in dry, one-sixth. The mineral is found at all depths, from the surface down to 180 feet and more. The usual depth is from forty to 100 feet. It is mostly pure, ready for smelting, and in a variety of forms; in solid sheets from one-half inch to four feet in thickness, vertical and horizontal. In some sections of the mines it lies mostly in openings, which are from two feet to twenty feet, and over, in width, and as

many in height. These openings and the crevasses in which the mineral is found, generally run in straight lines, and contain more or less of clay stained with oxide of iron, called ochre, and tumbling rock. Sometimes it is found in large caves, mostly filled with mineral, which yield many millions of pounds. The opening mineral is mostly found in junks of all sizes, some of many thousands of pounds in weight. The yield from a good mineral deposit, vein or range, would be from 1,000,000 to 10,000,000 pounds, and over. The smelters are now paying at the diggings fifty-five dollars and fifty-eight dollars per thousand pounds. There is a mine now being worked near the city of Dubuque, Iowa, called the Kelley mine, where they have raised from 15,000 to 25,000 per day, for many days in succession, some days much more. I am credibly informed it has turned out already over $500,000 worth of ore. The heavier and richest deposits are still undeveloped, as the earlier miners mostly looked for the surface or shallow mineral, and seldom reached the true lodes or veins. They can be easily and certainly reached, in many places, with some capital. Companies are mining in various parts of the mining region, and there is room, on as good mineral land as can be found anywhere, for many more companies to work.

FROM A RICH COUNTRY.

George Whitcomb, Charleston, Mississippi county, Mo.—Raised on a farm amid the bleak hills of New England, I know what work and cold fingers are, and neither of these suiting me, I concluded, thirty years ago, to seek a location where the one was unknown, and the minimum amount of the other would suffice. The selection was Mississippi county, Missouri, opposite the mouth of the Ohio, and my experience of thirty years proves the correctness of my selection. The county is a rich alluvial soil, called in western parlance, "river bottom," a soil every way as productive as the delta of ancient Egypt. Owing to the peninsula shape of the county, being nearly surrounded by the river, and the fact that a large water-course (James Bayou) runs through its center, almost the entire length, having as much fall in twenty-one miles as the river has in seventy-five, it is susceptible of being drained at a trifling expense. Probably there is not in all southeast Missouri an equal amount of land that can be drained and made arable at so little expense. Being entirely river bottom, of course, there is not a hill in the county, unless some hundred Indian mounds are entitled to that appellation,

nor a rock, except it has been imported for foundations, corner-stones, or obituary purposes. Brick, however, of the best quality can be made, and with them, and the superabundance of timber, the want of rock is little felt. Most of the county is heavily timbered—the predominant growth is cotton wood, black walnut, honey locust, black locust, all the varieties of oak, sugar tree, hickory, persimmon, pecan, mulberry, hackberry, and other species of timber usually found in the river bottoms. Upon the water-courses are immense "brakes" or groves of cypress, a timber equal to pine for building purposes, and superior to it for out-door work, such as weather-boarding, shingles, and fencing. The staple crop of the county is corn, yielding from forty to one hundred bushels per acre. Wheat does well, making from twenty to thirty bushels per acre, and in a few cases has done better than that. Oats do well, and the coarser grasses, such as timothy, grow very luxuriant, producing three and four tons to the acre. Cotton grows finely, and is raised in considerable quantities. Tobacco does well, but grows too large to be a favorite crop. Garden vegetables attain a size that would be deemed fabulous in the hills, or under a more northern clime; apples are very fine, but orchards are scarce, peaches are plenty, and all the small fruits grow luxuriant, and require but little cultivation to make large crops. The root crops, such as Irish potatoes, sweet potatoes, yams, turnips, onions, &c., grow very fine and yield largely to the acre; so do pumpkins, squashes, melons, and the leguminous vegetables. The Cairo and Fulton railroad runs through the northern portion of the county, commencing at Bird's Point, opposite Cairo, and passing through Charleston. The Iron Mountain railroad, running from St. Louis to Belmont, passes through the center of the county, and forms a junction with the Cairo and Fulton road at Charleston. With a river on three sides of the county, which never freezes or dries up, and two railroads running through it, certainly it has superior facilities for getting its productions to market; and as the rivers above the mouth of the Ohio are closed by ice much of the time in the winter, the highest prices are always obtained by the farmers for their grain, pork, and cattle, by shipping south at that time. Charleston is a pleasant village, situated in Matthew's Prairie, and surrounded by fine plantations; has a court house, two churches, a good hotel, several stores, saddlers, shoemakers, tailors, and blacksmith shops, and has a printing office, from which issues weekly *The Charleston Courier*. Belmont (named after the American partner of the Roths-

childs) is the terminus of the St. Louis Iron Mountain and Belmont railroad, and is directly opposite Columbus, Ky., the northern terminus of the Mobile and Ohio, and the New Orleans and Mississippi railroads. With the facilities of getting coal on the river, and iron by rail, it will doubtless become a large manufacturing place. But little snow falls, and the thermometer seldom gets down far below the freezing point. Those who appreciate comfort will hardly settle in such countries as the northern parts of Missouri, Illinois, Indiana, and Ohio, when they can find such a climate as that of southern Missouri, Kentucky, Tennessee, and Arkansas. Land can be had at all prices, from two dollars an acre up to five dollars; and ten dollars will buy good land. Improved lands will sell higher in proportion. To those who are looking for new locations, we say as Phillip said to Nathaniel, "come and see." I see by your reports that my old friend who dosed me so frequently with castor oil some fifty years ago, Dr. J. V. C. Smith, is a member of your club. If he will come out here, I will repay him in the oil line, as the bean grows plentiful, and is very productive.

Mr. N. C. Meeker.—I have been through this country, and can indorse all that is said of the fertility of the soil. Perhaps it has no superior in America. Apples do very well, especially Rawle's Janet; also all other kinds of fruits. Most of the farming used to be done by slave labor. In high water much land is subject to overflow. The musquetoes are so numerous at times that no one can count them. There is no doubt but the people have some ague. Formerly levees were built, but they have decayed, or they were imperfectly constructed. Wild fowl and game of all kinds, including wild turkeys, are abundant.

Adjourned.

May 19, 1868.

Mr. NATHAN C. ELY in the Chair; Mr. JOHN W. CHAMBERS, Secretary.

HOW TO MAKE GOOD VINEGAR.

Mrs. Kate, Warren, Penn., furnishes the following: To one gallon of molasses add nine gallons of soft water, and put the mixture in an open-ended barrel. It should then be stirred, and the barrel covered with a cloth and board, that nothing but the air can get in.

Receipts for making Whitewash.

Mr. Geo. Lee, Niagara Falls, N. Y.—Put one bushel of well-burned lime in a barrel, slake it with boiling water, add fourteen pounds of salt, let it stand two days, then take eight pounds of rice flour, and make four pailsful of paste, which is to be added to eight gallons of skim milk, and mixed with the wash. I painted my house with this mixture three years ago, and it looks as well as ever.

Mr. S. E. Locking, Perrysburg, N. Y.—Two quarts fresh lime, pour on boiling water, add a large coffee cup of salt, let it stand till cold, and add water to thin it. Use a common whitewash brush, add a piece of wood or leather on each side of the brush, to have the bristles extend from one-half to three-fourths of an inch, and the brush will last for years.

Mr. N. C. Meeker, a country gentleman living in New Jersey, writes a letter that he is obliged to stop using salt in whitewash for the outside of a house, because the cattle come around the house at night to lick the salt, which deprives the family of sleep.

Mr. Wm. Lawton.—Lime is a great preservative, and wood washed with it will last many years. It is often desirable to have whitewash of different colors, but the trouble is to get them to mix. The best way is to make a paste of lampblack, salt and wood ashes, then mix it with the lime. I have buildings that were painted twenty years ago, and to-day they look well.

Mr. Baldwin, New Haven.—The difficulty with whitewash is that it soon wears off. A preparation of lime, rosin and soap makes a good wash.

Sweet Corn for Hogs.

Mr. W. W. Dewey, of Meadville, Pa., says that last year he had a good deal more sweet corn than he needed for table use, and fed it to his hogs. He found the animals grow fat much faster than on common corn, and suggests that experiments be made with a view of ascertaining whether sweet corn would not be a profitable crop for those who fatten many hogs.

The Chair.—We recommend to Mr. Dewey to make the experiment himself and report the result to the Club. We will give it to the world.

Fish and Fish Ponds.

Mr. H. H. Macklin, of New Springfield, Ohio, asks for information. The Club refer all piscatory inquiries to Seth Green, of Mumford, Monroe county, N. Y.

Dr. Israel Jarvis.—The most important inquiry for this man is to know first what fish is natural to his waters. Maybe he cannot keep trout at all. The mountain trout must generally have clear water running through a primary—that is, a granitic or a sandstone country. But ponds for eels and bullheads can be established almost everywhere. Perch and dace also are easily produced.

Mr. Horace Greeley.—If he makes a trout pond he must be careful not to have it too deep, or deep in proportion to the amount of cool water supplied. If trout cannot find cool water they die.

The pond should at least be shoal at the upper end.

Mr. Wm. S. Carpenter.—Neither should the trout pond be too shallow, else the fish would perish in winter. An irregular bottom is best. He cannot be too careful about allowing the water to get warm. I remember many years ago carrying some trout in a tubful of the water from which they were taken. Some of the water was spilled, and the tub filled from a warm pond. It killed the trout. In the library of the American Institute, and also in the last report of the agricultural department at Washington, Mr. M. will find all the information he needs for a successful prosecution of the fish business. The Legislature of New York made Seth Green, of Monroe county, and Mr. Roosevelt, of New York city, special commissioners to have charge of the restocking of the streams of this State. The State of Massachusetts gave similar authority to Theodore Lyman, of Boston. The reports of these gentlemen are published, and can be had by writing for them.

DEEP PLOWING.

Mr. Arthur Boyrie, New York city.—Will the Club give the public a definition of the word plowing. Is it pulverizing, scarifying, disintegrating, or turning over? Every amateur farmer, every would be philosopher, every man of theory, constantly repeats, "plow deep." Gentlemen, with all respect, do you understand that of which you speak? Or are farmers such simpletons as not to know their best interests, unless somebody tells them? Farmers have adopted, without much telling, planters and reapers, and when they shall be offered an instrument that will plow deep and do it well they will adopt it. We have no practical instrument as yet, that I know of, that will plow deep; and I doubt if any implement constructed on the principle of the old Egyptian, or even the American plow, will ever do it; nor do I care if you run it beam deep. Now

we come again to the question, "What is plowing?" I will answer it: Plowing is pulverizing, loosening, making mellow, and not essentially turning over, your distinguished authority to the contrary notwithstanding. Nature never contemplated having a stratum of sub-soil, be it sand, or gravel, or clay, overlying a stratum of surface soil, and the farmer who would have the temerity so to do, would do it to his sorrow.

Mr. Horace Greeley.—When I bought a piece of land and began to take a practical interest in plowing, some fourteen years ago, it so happened that we had a very dry year. I noticed that fields plowed ten inches deep stood the drought and produced well, while those plowed to the usual depth of five inches gave poor returns. I visited the Mapes farm, now cultivated, and admirably cultivated, by Mr. Quinn. I saw twelve acres of tomatoes and as many of cabbages doing well, and defying the dry weather, because the field had been plowed deep. Every successive year has added to the fullness of my conviction on this subject. Some soils are an exception; but as a rule, the agricultural value of American farms can be doubled by plowing twice as deep as the practice now is.

Mr. Allen.—Will Mr. Greeley tell us first what he means by the word soil? I have seen earth that came from a depth of twenty-five or thirty feet, that would produce just as well as the surface.

Mr. H. Greeley.—By soil I mean that part of the earth practically useful to most of the plants we cultivate—that which is more or less aired or mellowed by operations on the surface, as distinguished from the gravel or hard-pan below.

Mr. P. T. Quinn.—The farm I cultivate has been alluded to. I would say of this surface, with which I have been familiar for eighteen years, that when our operations first began upon it, the soil was not over three inches deep. We have been getting down little by little, till now we have a soil that is from twelve to sixteen inches in depth, and all alike in color and fertility. The longer I farm the more importance I attach to the plow. All fine tillage depends on it. We plough in the fall, leaving the surface in ridges. Then we go twice over the surface in the spring. We have not gone down enough as yet. I shall not cease the use of deep or sub-soil plows till I have reached a depth of eighteen inches.

Mr. A. S. Fuller.—Can we not take a lesson from garden culture? Now, what gardener thinks he has a soil on which he can depend till he has carried his spade to a depth of two feet? Even for such

plants as the rose he wants a deep soil. Others coming into a flourishing garden, and seeing marvels of thrift and beauty, say the gardener has some secret which he won't impart. Mr. Chairman, I believe every gardener and small fruit culturist will sustain me in saying, we have no secrets in our craft. All we do is what you can do, and all can do—plough or spade deep, and enrich the earth till it is as fine and dark two feet down as most fields are for six inches.

Mr. N. C. Meeker.—This is a subject of much importance, for people would like to know exactly how deep they should plow. I think we cannot decide because soils differ. In the grape regions of Missouri, and on the Islands and elsewhere, they used to trench the soil two feet deep, but it was found disastrous to the crop, and now by plowing from eight to twelve inches, they are successful. The reason assigned is that the roots on which fruit depend, should get heat and air on the surface, and that the deep roots are for the life of the plant. The same is to be said in a great degree, of all the small fruits, though shallow plowing produces poor results.

Mr. Wm. Lawton.—This is a question of time and place. On my farm, where there is a hard sub-soil, I find it profitable to go two feet deep. But to practice that I find best, may not answer in all localities.

Dr. I. P. Trimble.—I agree with the last speaker. For instance, last fall Dr. Smith was my companion as we visited the southwestern part of New Jersey, in Salem county. I think he will agree with me, that he never saw in this country any better farms, any more careful, thorough, profitable tillage than among the Quakers of the lower Delaware. We asked them particularly about the depth of plowing. They said that years ago they had sunk the share deep, but of late had found no advantage from the practice. Now they are content with ten inches. I hope Mr. Greeley will, in his travels, go down among those warm-hearted, sound headed old Quakers. They would be glad to see him; they would treat him most kindly, and he would see one region in which his ideas are not practicable. They have a porous sub-soil, easily penetrated by the roots of plants, and we have no reason to suppose that very deep plowing would do any good; so at least they have found by many years experience. Those fields have been under the plow ever since the days of William Penn.

The Chairman.—As a sort of summary of this discussion on deep tillage, which has been before the club for several weeks, I think we may recommend to the farmers of all parts of the country to plow deeper and deeper every year, using manure in proportion to the

amount of sterile sub-soil exposed. Then, when a depth beyond which it does not pay to go has been reached, we invite farmers to report to us, and describe the nature of the soil and sub-soil.

Clover as a Fertilizer.

Mr. E. P. Myers, of Franklin, Indiana, reports favorably on the use of clover as a manure.

Mr. Horace Greeley.—That fact may now be taken as pretty well established. The practical difficulty with a great many soils is, they are too poor to grow the first crop of clover, so nothing can be obtained without considerable manure that is worth turning under.

Mr. W. S. Carpenter.—Clover is an excellent manure for lands remote from the barns, and places where little compost can be had. So also for hill tops and inaccessible fields. They can be greatly benefited by plowing under two crops of clover. There is no great extent of land in this country too poor to afford some clover. Get even a small growth, turn it under, and sow again on the sod.

Apple Tree Worms.

Mr. A. E. Raymond, of Niagara County, N. Y., complains bitterly of these pests. He describes the common canker worm, well known in New England, and asks what can be done to rid farmers of this pest.

Mr. Horace Greeley.—I have long held that every enemy of fruit trees that burrows in the ground may be successfully pursued and frequently exterminated by the proper use of salt. Fall plowing is also a good remedy, if the land is left in ridges. Freezing kills the eggs.

Dr. I. P. Trimble.—The canker worm has of late disappeared from New England. Those who have made its habits a study say a parasite comes and lays its egg in the egg or larva of the worm, and thus kills it. Birds are the best friends of the farmer in this respect, especially the cedar bird.

Mr. Allen.—Some years ago I had a fine shade tree beset with canker-worms. I tied a rough rope or band of common swingling tow around the trunk. When a brisk wind blew them to the ground, they would make straight for the trunk of the tree, but could not get over this rough band.

Mr. Baldwin.—I had in my yard five choice peach trees that ceased to bear, grew sickly, and had the yellows. I dug around the roots, and poured into the loosened earth a quantity of fish brine. In a

week the leaves had a fine, vigorous appearance, the trees bloomed and fruited admirably.

Mr. R. H. Williams.—It is well understood on Long Island that salt kills the wire-worm, and also that it is a special fertilizer for the plum. Some years ago I knew of an orchard near the sea. A tide of great violence flooded it, and every tree was killed by the salt water except the plums. They were benefited.

Plant Fruit Trees.

Dr. Wm. H. Long, Southville, Ky.—There are many farmers, who have their entire capital invested in their farms and necessary stock, who find themselves unable, without inconvenience, to spare the necessary amount to purchase trees for an orchard. Many of them have ground to spare for an orchard, and would grow fruit as a source of profit if they could procure the trees. I frequently hear the expression: "I would like to set out an orchard in that field if I only had the means." To this class I would make a few suggestions. Any man who can spare a few rows across his garden, or elsewhere, can, in three or four years, have all the fruit trees he wants. Let the soil be good, and prepare it by plowing well. Either in the fall or spring will do to plant, but the spring is preferred. Lay off in rows four feet apart. If apple seed cannot be obtained, the cores of those used in the family should be saved, or the pomace remaining after making cider. Drill these thick in the rows; and if cores are planted, mash every one when planted with the foot. If in the fall, they should be covered pretty deep; but if in spring, an inch is deep enough. When they have commenced growing they will require to be thinned to three inches, and transplant in missing places. Cultivate well for two years, and they are ready for grafting. In February, when two years old, dig them up, carefully preserving the roots, and bury them nicely in the cellar, or on the north side of a house or stone wall. Select your grafts from the best bearing trees in the neighborhood, taking the last year's growth only. Be careful to get a variety of summer, fall and winter fruit, and keep each kind separate and marked. Keep the cut ends covered with earth to prevent drying. A good grafting wax is prepared by melting together seven pounds of resin, one pound of beeswax, and one of tallow. Prepare your ground for setting out the grafted roots by deep plowing, and lay off rows four feet apart. Now, with the wax prepared and a sharp knife, you are ready. Anybody can graft who has mechanical

ingenuity enough to whittle a wedge. Take a few of the cions of one kind at a time; cut the brush or grafts into pieces about five inches long; then cut the cion off at the root, and split it nicely through the center for about one inch and a half. Take a graft, and, beginning at a bud, make a wedge from one inch to an inch and a half long, with the inner edge a little the thinnest; the bud being on the outer edge. Insert the wedge in the split root, taking care to let the bark of the wedge and root exactly come together, and with the wax, melted at hand, cover the split well; in fact, hermetically seal the wound; set out in the deep rows as soon as finished, and cover, leaving about two inches of the graft above ground. They should be set about six inches apart, cultivate well, and in one year many of them will be ready to transplant to your proposed orchard; and all of them will be ready in two years. The ground occupied in raising them will not be much; say you have four rows across one end of your garden, ninety feet long, that will give 180 trees to the row, and 720 in all; or, if the rows are only thirty feet long, they will raise 240 trees.

Mr. N. C. Meeker.—To this we add, that if the ground is rich, and the culture good, the trees may be budded in the fall of the first year. We would advise any one who would grow fruit trees, to get *The American Fruit Culturist*, by J. J. Thomas. It will be worth a hundred times its cost.

Forest-Tree Planting.

Mr. Samuel Edwards, Bureau Co., La Moille, Ill.—I am glad to see the interest manifested in timber planting by the correspondents of the Farmers' Club. There is no question of more importance claiming the attention of our people, particularly on the prairies. In 1801, Henry Root, of Cayuga Co., N. Y., planted a nut of black walnut, and eight or ten years since he cut down the tree, three feet in diameter. He lives in the enjoyment of a hale old age, regretting that he did not plant acres instead of a single nut. The white maple is probably the most valuable of all the rapid growing trees. Lombardy poplar grows readily from cuttings a foot long, planted early in the spring, in well prepared soil, and the dirt pressed firmly at the lower end, at least two-thirds in the ground, as do all the poplars, including cottonwood and the willows. Silver poplar is valuable as a street tree, and for play grounds of school-houses. Black walnut, butternut, chestnut, hickory nut and the oaks are propagated by getting

the nuts in the fall, before they are dry; mix in layers with dirt, at a depth allowing all to freeze, plant in April as soon as the ground is in good condition, cover as deep as the diameter of the nut, either when they are to remain or in nursery rows, to be taken up and buried the next winter, secure from frost. By cutting one-half of the tap roots at one year, lateral roots put forth more abundantly, and the trees are more successfully transplanted in after years than otherwise would be the case. It is to be hoped that this class of trees will receive immediate attention by planters on the prairies, and wherever timber is scarce, as they are indispensable, and require a comparatively long period to mature. As to evergreens, the day is at hand when they are to be planted all over the prairies as shelter belts for buildings, stock yards and gardens. A double or triple-row screen is equal, as a protection from the winds, to a stone wall of the same height. Foreign varieties, until recently, have been imported from Europe. Often a great part were fatally injured, and of four importations made by myself, only one was successful. They are now grown in this country. The great secret in handling evergreens is, *to keep the roots constantly moist.*

Cultivating Peach Orchards.

Mr. Wm. Abernathy, Pontoosuc, Ill., writes that some years ago he planted a peach orchard with choice varieties, and gave the very best cultivation, but they made such a rapid growth that in the third winter they were killed to the ground. Cutting off the old trunk eight inches above the ground, they sprouted up and made thrifty trees. Hence he thinks cultivation injurious, and he keeps his orchard in blue grass with the best results. Now it is understood among peach growers that for market purposes there can be no success by this method, though one may have abundance for family use, and even sell some. The proper way is to give high cultivation from the opening of the season to the first of August, and then stop, that the buds may mature and not be pushed off by the abundance of sap, and particularly that the wood may harden so as to go through the winter, whatever may be the climate. It is probable that our friend's failure arose from fall cultivation, which give a strong growth up to the time of frost; the trees were filled with sap, and they had no more chance of living than a hill of green corn.

Toward the close of the session, Mr. Rufus Nutting, secretary of the Vermont Agricultural Society, was introduced, and he read a long paper on the value of

Farmers' Clubs.

After alluding to the fundamental and perpetual character of the agricultural interest, Mr. Nutting proceeded as follows:

"I would fain say something to arouse you, fellow-farmers, to a sense of your situation and responsibility, to lead you to magnify your calling and make it honorable, more honorable, most honorable. To this end I would enforce upon you the importance of recommending the organization and sustaining of farmer's clubs or farmers' lyceums in all parts of the country. I know of no means by which so great and good effects can be produced with so little expense of effort and money. The reports of the American Institute Farmers' Club constitute one of the great attractions of those papers which regularly publish them to a great proportion of their country readers, and they are often referred to as authority upon disputed points. While this Club, I suppose, exists chiefly if not wholly for agricultural improvement, I think country clubs should have other objects as elements of permanency and interest. As an illustration of my views, I will mention the "Randolph Farmer's Lyceum," which was organized six years ago, by the persistent efforts of one man, with thirteen members, and has continued till it now numbers over 100 members, with continually increasing interest and usefulness. Its objects are, the acquisition and dissemination of agricultural knowledge; promotion of acquaintance, and friendship among townsmen; personal improvement in thinking, reading, writing, and speaking; improvement of farms, buildings, implements and stocks. All other subjects excluded. Its good effects are very perceptible in the increased spirit of inquiry and investigation which exists; the greater number of agricultural books and periodicals read; the better employment of spare time in reading and writing, rather than in indolence and vice; the increased willingness of farmers' boys to stay at home, instead of hurrying off to the city for other business; in the greater readiness to make *experiments* in all departments of farming, believing that all but divine knowledge is the *result* of experiment; the improved appearance of farms and farm buildings; the better adaptation and construction of buildings to the ends sought; the improvement of all kinds of farm stock; the increased amount of barn manure made and stock kept; the increased fertility of the soil; the better quality and greater number of labor-saving implements; the good will and kind feeling promoted among the members; the development of dormant energies; powers

of thinking, reading, writing, speaking, and influence not before supposed to exist. No one acquainted with the facts can question that these and similar benefits have resulted from the existence of this institution for the last six years, at an annual expense to each member of about eight cents. The results have not been confined to those only who have attended the meetings, an indirect influence has been operating through the whole vicinity, the effects of which many years cannot obliterate. I know of no reason why similar effects would not result from a similar institution, so long, in almost any other locality. One or two efficient men, with a proper understanding of the case, to act as engineers, always on hand, with fuel for fire, lubricating oil, and tools for repairs, is all that is wanted. As an indication of what is done at our weekly meetings from November to April, the following have been among the subjects of orations, essays, impromptus or discussions, the past season: Butter factories; Fall v. spring plowing; General and specific agriculture; Importance of extempore speaking; Farming *then and now;* Latent powers of man; Beast and soil; The potato crop; Best manner of feeding stock in the fall; Who is the best farmer? Wintering sheep; Application of machinery to farming; Will book-farming pay? Influence of agriculture; Horse-rakes; Shall we sell our surplus feed or buy stock to consume it? Wintering stock and feeding cobs; Effects of farming upon the disposition; Advantages of warm stables; What kind of stock is most profitable; Barn building; Farm fences; What stock improves the farm most? The comfort of farm stock; The hay crop; Irish farming; Stock raising; Soiling; Uses of wrinkles on sheep; Maple sugar making; Bee culture; Fruit raising; Farmers' pumps; Objects and construction of barns; Raising calves; Making farmers' homes attractive; Best method of keeping cows; Haying implements; How to make boys love farming; Ventilation of stables; Best kind of fruit.

Now, gentlemen, by reason of your central position and connection with great journals your power to influence public opinion on this subject is very great. You can promote this fundamental interest of society in a remarkable degree by suggestions made at the right time and in the best way to the communities which your proceedings reach. Will you do it?

Mr. Carpenter.—This organization of which our visitor from Vermont has so high an opinion, and perhaps not without reason, is now twenty-eight years old. It was organized in the year 1840, by

Mr. Wakeman, who had witnessed the good effects of such organizations in England and on the Continent. We originally met in the old city hall and removed here soon after the completion of this noble edifice. Other clubs have sprung up all over the country, modeled after this and encouraged by the success that has attended our efforts, to draw out and lay before the county opinions, experiments and discussions on agricultural topics. There are more than a thousand such clubs in various parts of the land, and there can be no doubt as to the signal and permanent good that flows from them.

Hand Hoe and Corn Planter.

This combination, exhibited by Mr. Sogg, the patentee, consists of a capped tin vessel holding a pint or more, fitted at the head of a hollow hoe handle. In holding it the uppermost hand rests on a spring moved by a slight motion, so that a given number of kernels, as five, can be instantly released. They run down the inside of the handle and fall just where the planter wishes them to. It was left with the Secretary, who will have it tested in the cornfield and properly reported on.

Adjourned.

May 26, 1868.

Mr. Nathan C. Ely in the Chair; Mr. John W. Chambers, Secretary.

Southern Illinois.

A letter was read from E. K. Griffin, Equality, Ill., an old correspondent of the club. This is not a new country. Equality is situated on an ancient road leading from Shawneetown to St. Louis, and is reached by boats in the winter and in times of flood, being on the Saline river. A railroad is to be built to the Illinois Central. There are beds of coal and salt wells, where sufficient salt is manufactured to supply the surrounding country. It is a good fruit region, and peaches have not failed for four successive years. Clover and grass do well, and winter wheat is a sure crop. Small farms, with log buildings, can be bought from ten dollars to fifteen dollars an acre. Money always commands ten per cent interest, with good security. Wages are low. Poor people in country places live by renting land; but we have too many of this class. Snow drifts are unknown; musquetoes seldom annoy; the fever and ague is running out; consumption uncommon. It is not a good place for doctors or lawyers; and, being clad with a good conscience, we are not impres-

sible to high priced eloquence. We are sociable. Sunday visiting is common, and tolerated by the most religious. In public dinners we are not excelled; and none are despised because they come in ox wagons, or clad in homespun. If we have little wealth, it is not owing to a want of ability that we do not acquire it. Our women are ignorant of French inventions. They glory in bearing fruit, and are proud of it.

THE IMPORTANCE OF PLANTING CORN.

Mr. Solon Robinson, referring to an article in the *Tribune*, from which he differed in opinion, said he wished to call the attention of farmers now to the importance of getting in just as much corn as possible. As a nation, we shall need more food next fall, and every acre planted in corn is so much more toward the bread supply.

Some discussion followed as to the latest date for profitable corn planting. Mr. S. Edwards Todd said one year he planted on the 26th of June, and made just as good corn and as much of it as from that planted on the 26th of May. Others said they would not plant after the 15th of June. Others said it makes much difference whether the corn is planted in poor or rich, warm land; that corn is a tropical plant and loves hot sun, and, in favorable soils, will come on and mature, yielding a full crop though planted as late as the middle of June.

Mr. J. B. Lyman then proposed the following resolution, as a formal expression of the views of the club on a subject of much importance:

"*Resolved*, by the American Institute Farmers' Club, That, in view of the peculiarities of the present season, and the great importance of supplying our market with an abundance of food, we recommend to the farmers of this country generally to plant this spring as large crops as possible of Indian corn, and that little risk of a mature crop on well prepared land is taken by planting corn any time before the middle of June."

Mr. Solon Robinson.—I hope that resolution will pass the club. Of course, it is understood that it relates to the region near New York city. We are not recommending the people of Florida or Texas to plant corn at a time when they sometimes have roasting-ears. But in the north, and especially the northeast, we take this mode of expressing our conviction that the material prosperity of our people, and the comfort of the poor, will be promoted by large crops of Indian corn; and therefore we say to the farmers, plant more corn than you

at first planned for, and if in the press of spring work, or by reason of unusual rains and cold weather, you cannot get it into the ground earlier than the middle of June, plant then at her than not at all.

Mr. N. C. Meeker.—The article referred to took into view the whole country, and in particular the great corn region of the west, not the seaboard where they raise little corn. To secure a fair crop in the west, where large fields are planted, it is of the utmost importance to plant early, in order that the crop may be laid by before the wheat and grass crops require attention; for if work is demanded from each at the same time, one, at least, must go by default, or at the best all will suffer. There is no such thing as having a prosperous season in the corn region of the west if corn cannot be planted before the 1st of June. Still, corn may be raised if planted even so late as the 1st of July; but this must be on quick, warm soil. This has no reference to the great crop of the country on which much food other than bread depends.

Mr. Horace Greeley.—I am in favor of the resolution offered by Mr. Lyman, especially if the words are so modified as to convey the idea that in late planted corn the ground should be rich and the field well prepared for seed, so that no delay or back-set be suffered. But I would urge our farmers not so much to planting area as to better cultivation and getting more from an acre. I move over some portion of the west almost every year, and I can see the corn getting smaller every year. On an average the cornfields of Iowa and Illinois do not look better while growing, or show bigger stubble when cut than the cornfields of New Jersey or Connecticut.

Mr. Wm. Lawton.—I shall vote for the resolution, for it conveys a timely and important hint to the whole farming community. But we cannot be understood as prescribing the best date for corn planting for the whole country. I have raised excellent corn where the field was not planted till the 3d of June.

Mr. Theo. C. Peters, of Western New York.—In our country we often make good crops of corn, planting after the 10th of June. In a trip which I have made of late to the west, I saw no signs of a scant crop of corn, but there is no danger of planting too much, and I hope the resolution will pass.

Upon vote taken the passage of the resolution was decided unanimous.

Florida.

Mr. Solon Robinson, read the following paper as an answer to many inquiries: "H. D. Dickey, Bedford, Cuyahoga county, Ohio, says several families wish to emigrate to Florida, if they can gain sufficient information in regard to the heat of summer. That seems, also, to be a leading question with all who write me, none of whom can I answer privately. The labor is too much for my strength. If the writers knew how little power I have for all my necessary labor, they would not tax me to greater exertion. The climate is no hotter nor harder to bear in Florida than in New York, only it is longer continued, and Northern people, before they learn enough to suit themselves to the new condition of things, are apt to suffer. All tropical climates are enervating. Florida is not an exception, but it is not, generally speaking, a sickly region; yet immigrants should exercise common sense in their locations, and keep on dry land, and build their houses in pine woods, but never in a jungle of shade, which keeps the house damp in the rainy season, which is the warmest and most sickly. The heaviest work must be done in winter and spring; the least in July, August and September. A farmer has eight or nine good months, and if he lives there as he does here, and exercises proper care, he will live longer and more healthy, on the average, and far more comfortably than it is possible for any man to live here.

I wish people would try to learn that Florida is a wilderness; the most so of any of the States. It is a newly discovered country. It has been only open to civilization two or three years. The State owns a vast portion of the wild lands. The price is fifty cents an acre. The United States land is $1.25, or next to nothing to the actual settler. The Florida Railroad Company, Fernandini to Cedar Keys, gives land to actual settlers. Farms can be frequently bought for less than cost of improvements, from five dollars to fifty dollars an acre. If you want a choice location on the banks of the St. John's, with a good house and a bearing orchard of orange trees, you will have to pay a moderately high price. Good wild lands in large tracts, on the river, can be bought at six dollars to sixteen dollars an acre. Any where near that river is a good place for northern immigrants to locate "for gardening purposes," or any other purpose. The safest, most profitable, cultivated crop, in my opinion, is sugar cane. It ripens as well on the St. John's as it does in Cuba. The land is not

generally so rich as the sugar estates of Louisiana, but more profitably worked, and yield greater.

What facilities for getting produce to market? is an oft-repeated question. I answer: Steamers from St. John's, three times a week, to Savannah and Charleston, and thence by sea to New York; or daily cars from Jacksonville, express to New York in less than four days. Fruits—What sort succeeds best? Oranges, figs, apricots, nectarines, peaches, plums, bananas, and several other fruits succeed admirably. *Wheat?* Not cultivated. I am told it has been grown successfully in the upper part of the state. *Rice?* Yes, upon suitable land, which is abundant, and not very good for other crops. *Corn?* Yes, small yield; generally ten or fifteen bushels per acre, with no hoeing, and manure none. *Potatoes?* Yes, delicious. I ate as fine ones as I ever tasted, on the first of March, at the Putnam house, Palatka, which I saw dug that day. The seed was planted in November. Tomatoes were abundant in the same garden. *How will it answer to go with only a small capital?* Just as well as into any other new country; inconvenient, but not impossible. *Mechanics?* Plenty of work, good wages, and no more difficulty about pay than in any other country. The demand for carpenters at Jacksonville is strong. *History.* Where can I get a good one of Florida? None for sale that I know of. J. S. Adams of Jacksonville is writing a pamphlet, "Information for Immigrants." *The Gulf side, how is that?* Good, but I prefer the Atlantic side, and close connection with northern cities, direct by rail and sea. *Route from Ohio to Florida, and Cost.* The question is too indefinite. Ohio is a great State. So is Florida, it is considerably larger than Ohio, and the routes to the different portions are entirely distinct. The cost by rail, New York to Jacksonville, forty dollars. It is less by steam, and still less by wind. To get from Jacksonville to the west, the easiest way is hard. You would find it equally so to get to Pensacola; worse than a journey back to New York. From Southern Ohio to the Gulf side of Florida, go via. New Orleans. To the east side, via Nashville and Savannah, or via New York, Philadelphia, Baltimore, or Washington.

Investing Capital in Florida.

"Is it safe?" Yes, perfectly. William B. Harkness, Philadelphia, says he could get men to aid him in establishing a plantation in Florida, if they could be satisfied it was safe, as he has had experience in Texas, which the war compelled him to abdicate.

I repeat, it is safe; and in a few years nearly all the capital and most of the population on the St. Johns will be northern. The laboring portion of Florida have no money. The great want is capital, and brains to direct it. The day of great plantations, however, is past. They must be broken up and farming substituted. And men must learn to work. At present, where 200 bushels per acre of sweet potatoes grow with but little labor to cultivate, and none to preserve over winter, families are destitute half the time.

"SHALL I TAKE MY FAMILY?"

Three brothers, with about $1,500 joint capital, wish to go from this city and start a place in Florida, if they can do so upon that capital, but they propose to leave their families here until they make something to support them there. That would be a fatal mistake. Go on board a sailing vessel in October, and to Jacksonville. Rent a house there until you can get one in the woods, and start a garden, pigs, poultry, and have a cow. In March you will begin to live from your own land. You will have a hard first year, and pleasant homes after that. You may buy or rent an improved place, and grow something to sell the first season. Don't be discouraged if you do not. If you do not take your families with you, it is doubtful whether you will stay long enough to know whether the statement is true that you refer to—that is, that one man sold $22,000 of garden truck from fifteen acres on the St. John's. I do not doubt its truth.

To an inquiry of Mr. Lyman as to the age of orange trees, Mr. Solon Robinson said that previous to the great frost of 1855, which killed the trees, there were some which had been in bearing one hundred years. Mr. Fuller said that there were some orange trees in botanical gardens in France which were 400 years old. Mr. Robinson then spoke of peach trees, saying that they grow to enormous size, are free of disease, and they bear so abundantly that the fruit is fed to the hogs, while the people are so lazy that they get dried peaches from New York.

Mr. N. C. Meeker.—I would like to inquire what is the prospect of the posterity of the northern people going to that country. Are they not likely to become enervated by the climate, and in the end equally worthless?

Mr. Robinson mentioned the names of several gentlemen from the north who have been there some twenty, and others a less number of years, but their families had not degenerated. Whether they were farming or in business and living in towns, he did not state.

The Hon. T. Peters, of western New York, having spent the winter in Florida, said that there were great advantages for a poor man there, since he has few or no preparations to make for the winter. The best business to engage in is gardening. The raising of Irish potatoes and sugar will be very profitable.

The reporter must add that folks may have another fact, that he has a family for next door neighbors who have lived in Florida for several years, on the St. John's river, and they state that there is such an immense number of fleas in the sand, that if one undertakes to carry a measure of sand a half a mile, a considerable portion will hop away—and this at all seasons.

A Display of Pine Cones.

Mr. J. E. Warren, lately from California, late editor of the *Wool and Stock Journal*, was then introduced, and laid before the Club numerous and remarkable specimens of pine cones and pine seed from California. He showed the cone of the *Pinus Colteri* obtained on the peak of Mount Diabolo, and of the *Pinus Sabiniana* found in the same difficult height. The cones of the *sequoya gigantea* or mammoth pine, are remarkable for their small size. They are not so big as a hen's egg, while the cones of the colteri, the sabiniana and the sugar pine and the ponderosa are all of great size, some over two feet in length. He had found a few specimens of the *P. Bractiati*, very rare and almost impossible to be obtained on account of the enormous grizzly bears which infest the remote and lonely peaks where they grow.

Inventions.

Mr. R. Nutting, of Randolph, Vt., showed an improved fanning-mill and separator, which was operated in the club room, and excited much interest. His explanation of its workings was accompanied by some excellent remarks on the importance of sowing good seed, and good seed only. He thinks we should be as careful of kinds and qualities in the seed of grain as in the breeding of cows and horses. His invention enables the farmer to do this by giving him a screen in his fanning-mill, which will divide the best grain from such as is inferior and unfit to be sowed, and also all seeds of weeds, while it is at the same time a cheap, practical fanning-mill, costing the farmer but forty dollars.

A model of Warner's sulky revolving rake, made by H. Fay & Co., of North Williston, Vt., was shown and commented upon by Mr. S.

E. Todd. It works easily, is readily transported, and is not readily broken, and can be repaired on the farm.

Hand Corn and Seed Planter.

Williams & Merrick, Sebeck, Maine.—This has a small seed-box fastened to the neck of the hoe, and a slide along the handle, by which a valve is opened and closed; and there are metallic blocks of various sizes, for different kinds of seeds to pass through. It was given to Mr. N. C. Meeker for trial.

Fence Posts.

Mr. H. Stewart, Sherwood, Iowa, stated that there is no difference in durability where posts are set top or butt down; it is more important to have good material, and this is to be had in the butt, not in the top of the tree.

Mr. H. Greeley.—I wish to state precisely why posts should be set with the top down. The construction of the fibers, grains and pores of the wood is such as to absorb moisture. Now if the top is set down the structure is reversed; and posts, I do not say of all, but of many kinds of wood, will last longer by being set top down, thus repelling moisture.

Mr. A. S. Fuller could understand this, if it were not a fact that when live wood is reversed the sap will rise in an opposite direction, as is the case with cuttings. The only question is whether dead wood will act in the same way. I think it will.

Deep Plowing.

Mr. Wm. P. Passmore, Fainsville, Chester county, Pa.—The bare fact that we do sometimes dig materials from the bottoms of wells that prove on exposure more fertile than the soil above, is not evidence that the subsoil is always of like character. It has so occurred in my experience. When a boy, working for my father, who was a great admirer of Judge Buel, and *The Cultivator* of years ago, we set a bar shear plow built expressly for two pair of stout cattle, at twelve inches deep, and kept that depth throughout the field. The result was a very inferior crop, and some disappointment. I waited to see the improvement, but to my eye the damage was plain more years than friend Quinn has been plowing in Jersey. Neither is it true that the system of farming pursued in those days has produced the evil consequences attributed to shallow plowing, such as short,

unhealthy growth, insect ravages, and diminished average crops. I am tired of this poor-mouthed croaking. One would think from the tenor of our modern papers that the present farming community are a miserable set of thriftless blockheads, and that even our wives could not make a cup of coffee or cook a steak. The truth is our system has doubled and trebled the produce of Chester, Delaware, and New Castle counties, and advanced the price of land from eighteen dollars per acre to $150 and on upward. That system is generally practiced in these parts to-day, and is founded on a seven-field course, first: Corn, with lime applied in quantity, and manure as suited the fancy of the applicant, mostly forty bushels per acre, spread the fall preceding. Second. Oats, barley or potatoes, or all of them, followed in the fall by wheat, with all the manure that could be made on the farm and seeded to grass, which was often allowed an annual dressing of one and a half bushels plaster per acre, until that field's turn came again for corn. Some farmers had other resources than the barnyard for manure, but the great improvement of this section of country has been effected under this system of culture, and by men nearly all advocates of deep plowing. Yet our best farms are only plowed eight inches deep, and this depth has been gradually acquired. There are many of us, who are fast growing to be old farmers, that remember the sedge grass and rabbit fields of our boyhood, which being brought under this process, are now the finest green grass pastures, and produce from fifty to one hundred bushels of corn per acre. True, this system was established by our fathers, and in the old fogy times, but it has resulted in many thousand comfortable, and even elegant homes, churches, schools, mills, shops, &c., all built up by this shallow system. For this reason the Club should pause before adopting friend Greeley's recommendation, to turn this immense tract of highly productive soil upside down two or three feet under ground. Now I never wrote where there was danger of being printed before, but if thee would like to see the proof of these things, write me a note and I will attend to it, and if thee comes, I will show thee a broad extent of well-cultivated country, an acre or two of old sedge grass yet, and some fine farms owned by men who started life as farmers as bare-handed as hands are made.

Mr. N. C. Meeker, says that Mr. Greeley is misunderstood. Last week he decidedly said that a farmer should start with eighteen inches of fertile soil as a capital, and he expressly disclaimed advocating the turning of barren subsoil to the surface.

PRUNING MELONS.

Mr. W. T. Parker, Birmingham, Erie county, O.—What have the market gardeners to say about pruning melons? Should the vines be pruned, or should only the number of melons be limited? If we are to stop the vines, shall it be leaders or laterals, and with plants six feet apart how many melons are allowed to a hill?

Mr. N. C. Meeker.—Market gardeners do not grow many melons, as too much space is required, the proper distance being eight feet. Nor do they thrive on heavy soils. On the Jersey sands they grow abundantly, and no attention is paid to pruning. This is an old English method, common to the gardeners of the nobility, and perhaps necessary in a cold climate or under glass. There is scarcely a doubt that if one in this country should take English books for a guide that he would learn more false than true things. They may be applicable in England — though we suspect some of them to be mere vagaries, having their origin in ignorance, or in attempts at appearing wise in the eyes of superiors.

THE CURRANT WORM.

Mr. M. Quimby.—It has been recommended to put out slips of the currant extensively in sections where the worm has not appeared, for the purpose of supplying the deficiency occasioned by their ravages. Having a little experience just here discouraging such proceeding, I would advise a little caution. As they are travelers, by the time the bushes are ready to transplant, the worms may be on hand to destroy them. They are said to be migratory in their habits, remaining but a few years in one section. The diminishing numbers here in the Mohawk valley is one evidence that they will eventually leave us. Yet this result may be owing to the fact that the currant and gooseberry bushes are so nearly all killed, there are not leaves enough left for an abundant brood. However this may be, the question to be answered is whether it will pay to keep off the worms, for the currants we get from year to year. If we decide it will not pay, and dismiss them without further trouble, the bushes are usually killed the first summer. But if we want currants, and are willing to work a little for them, like most other things, they may be had. But no half-way work will suffice. It will not do to wait till the worm has attained its growth, and then sift on some road dust, lime, ashes, or other mild material, and think because they disappear they are all killed. It should be remembered that there are three or four generations in one

summer, and when the full grown ones disappear suddenly there is really much to be apprehended. The worm enters the ground, and in a few days emerges as a beautiful little golden-tinged fly that is ready to deposit eggs for another brood, and when all of the first are gone, a still greater army may be expected. The most effectual remedy known to the public is white hellebore in powder. This dusted over the bushes thoroughly, while they are moist, or if the leaves are dry mix with water, and with a wisp or brush wet all the leaves. Do this to each brood as soon as practicable after they appear, and your bushes are safe. The berries are never taken, but do not ripen properly without the leaves. By allowing the currants to remain a few days exposed to the weather, and thoroughly washing before using, no bad effects will follow eating them.

The Rose Slug.

Mr. M. Quimby.—A great many persons have seen statements in papers that two or three ounces of whale oil soap, dissolved in a gallon of water, will, when properly applied, kill the rose slug. But how many do it? A great many having no particular fancy for roses will take no pains to save them. Others fully intend to apply the remedy the present season, but the soap is to be purchased of the seedsman or druggist, and is neglected, till some morning nearly every leaf appears like so many patches of beautifully notched coarse brown paper; the cellular tissue being all consumed by the slug. Then it does not pay to do anything, unless to kill off a few, and make a less number another year. Others, again, would willingly take the trouble if they knew how. I propose to say how I did. A small black fly, three-eighths of an inch in length, with large wings, deposits its eggs soon after the leaves appear, which hatch in about a week, at first too small for the naked eye. When they can be seen it is time to operate. The worm has to come to the upper side of the leaf to feed several times during the day, at which time they should be sprinkled with the above mentioned whale oil soap-suds till every leaf is wet. Every worm or slug that is touched will be killed. A part of them remain on the under side and are not touched; but in a few hours two or three will come up for a meal, when another sprinkling will finish them. As much later, another sprinkling finishes the whole. If the eggs for these worms were all hatched at one time, the labor could all be done in a day; but as the laying extends through a period of a week or two, the hatching will be in

the same way, and if you wait for the last to hatch the first will have destroyed many leaves. It is best to make thorough work. Kill those that hatch after the first sprinkling by going over the bushes another day. When this is done it will last for years, unless careless neighbors preserve seed for another year.

THE WASTE OF FERTILITY.

C. S. Osgood, Wright City, Warren county, Mo.—Fertilization of the soil in most parts of the country is the *great* one thing needful in farming. Ordinary lands produce fair crops when the weather and season is favorable, but highly fertilized lands nearly *always* produce well. When we took the land from nature it was nearly all rich enough to produce heavy crops; and it is entirely discreditable to us that instead of improving, it should greatly deteriorate under our management. With almost any soil level enough not to wash badly (and no other ought to be much cultivated), I hold it to be entirely unnecessary and poor economy to have less crops than can barely stand up and .ripen well on the ground. And to accomplish so desirable a consummation nothing more in the world is wanting than good ordinary cultivation and a return to the soil, without material waste, of the crops that are taken from it after being consumed by animals, either brute or human. It is a theoretical and practical fact, that such a course of treatment, faithfully applied for ten years or less, will enrich most soils *above* the point of good production. The one *great*, *glaring*, defect of our farming is, that of all the elements of fertility drawn from the soil by crops, not one-fourth is again returned to it, but the great majority, by various channels, finds its way to the greedy, all-absorbing sea, perhaps to be of use in some future geological era, but lost to us entirely. Nature seems bent upon the job of denuding the land of its fine and fertilizing matter, and the great majority of mankind are stupid enough to help her to despoil them, or at least to offer no resistance. If the sea were not deeper than the soil, it would long before now have become one vast reeking cesspool. Beside the enormous amount of food and other products of the soil consumed in cities and towns, of which all but a slight fraction finds its way to the sea, I estimate that quite one-half of what is consumed on the farms themselves goes the same way, and in all this western country a very much greater proportion. I have this spring paid my full share of tribute to the Gulf of Mexico, expressed via the Mississippi

river. I paid it under strong protest, but could not help myself as I am on an old slovened slave plantation, and haven't had time to get things fixed yet. But I will try to be ready for it another year, and deny the gulf my quota of liquid manure. I have lately come to this country from the east, and am pleased with the change. But if I had had a tolerably level farm there in a good neighborhood, I should not have left it, and wouldn't now, but would stay and show people what could be done by saving manure, not making or buying, for neither is requisite, but merely taking care that what is naturally made on the place in feeding the crops does not get away through any of the many channels of waste. I don't believe in much handling over of manure. It is not manipulation that it wants, but the elements that crops are composed of, such as carbon, nitrogen, potash, phosphates, &c., which are produced by rich feed, and not by manipulation. In feeding hogs or other stock with grain, or other rich feed, much good absorbing material of some kind needs to be supplied, not to make manure, for it won't do that, but to absorb and hold the volatile and soluble matter, which would otherwise be rapidly and largely dissipated into the air, earth and water. It is extremely wasteful to keep high-fed animals. The course pursued by me with entire success after getting awake to the subject, was to keep my cattle in the barn all the time in winter, never feeding a straw in the yard, but feeding in the barn twice a day with good hay, and then about twice as much straw or other rough fodder as they would eat, clearing the mangers once a day, or oftener, of all the refuse to bed them with. And instead of cleaning out the stable every day, I kept covering the dry litter till it got too deep for convenience; then fork off the dry from the top to start a new bed with, and throw the wet out in a compact heap in which fermentation had been started, which is not apt to run high enough in neat cattle's manure to do harm, but merely keeps the pile warm enough in winter to rot the straw nicely, the humus formed of which absorbs and holds the ammonia developed from the urine, &c. A pile thus formed and properly cared for will in spring cut with a shovel "like old cheese," and still have retained all the elements of the crops that formed it, and, returned to the soil whence they came, will restore to it all the fertility those crops extracted from it in growing, except a small, unavoidable waste. In the meantime the soil itself has not been idle, but has been accumulating with rapidity, according to circumstances, the elements of fertility, by the absorption of volatile and gaseous

matters from the air and from rain water, and has developed salts and the mineral elements of plants by the oxidation and decomposition of its constituent particles, hastened by disturbance of the plow and harrow, so that the succeeding crop should much exceed the last, and so on till the point of highest production is reached. On the score of economy, as well as health and decency, no farmer should allow any appreciable amount of stench or noxious effluvia about his premises, from whatever source, as such perfumery costs more than Phalon's or Lubin's. And so simple and handy a deodorizer as loam, liberally and often applied, will render cess-pools, hog-styes, privies, &c., nearly inodorous, and their contents inoffensive to compost and cart, while the amount of fertilizing matter thus saved, would surprise any one who had neither tried it or thought about it, as is the case with most farmers. A great error is very prevalent with most farmers, in supposing that of a crop the straw is of more consequence to return to the soil than the grain, which undoubtedly arises from their losing most of the grain from not using absorbents, and perhaps applying what they do save, in a way to injure other than benefit crops, as I once knew a saphead to spoil a part of his yield of corn with hog manure that should have made a great crop of the whole, while other parts of the same field suffered from poverty of soil.

A Factory Operative in Kansas.

Mr. L. L. S. Ruggles, Salina, Kansas.—A correspondent of the *Springfield Republican*, writing from this State, says: "To live in a shanty and eat pork and corn bread, does very well for a change, and for a short time; as a regular thing, from which there is no escape, it soon becomes tedious to those who have been accustomed to something better. The Springfield mechanic, who will live as roughly and cheaply there, as he must if he becomes a pioneer farmer, will be richer there at the end of five or ten years, than if a western homestead had been given him." Every phase of life hath its shady as well as sunny side, and the Springfield mechanic must know he cannot wholly escape the necessary inconveniences of such a life. We cannot all expect to keep sugar plums in our mouths through life, neither can we afford to leave the west to the government of the hardy foreigner. Being all my early life a Massachusetts mechanic, and my wife being brought up, as it were, in a cotton factory, we not only individually, but collectively, "speak right out in meeting," and take oath, after a pretty thorough trial of some dozen years, in

four western States, that we most certainly prefer the pioneer life in our own shanty, to the shop or factory of an eastern capitalist, and our own soil to that of some eastern landlord, and we find this pure electrical air, as it comes sweeping down the declivity from the Rocky mountains quite as invigorating as the foul, greasy air of a cotton mill; and we do most solemnly declare ourselves fully as much inclined to good, light, wholesome corn bread, and pure, sweet milk and cream, with a sprinkling of juicy, tender buffalo beef, as we are to the filthy lard, pies and cakes, and fried pork of a factory boarding-house. And we further declare that this magnificent scenery is a continual inspiration, and fully as ennobling as we ever found the gray walls of a factory to be. Here we see a future for our children, while the eastern mechanic sees nothing but daily toil to leave his offspring, though his wife may wear silk dresses to church, and his children medals from school. We have lost all fears of our children growing up fools, for we find that all necessary education is not taught even in a New England school-house. Let the mechanic there remember, while he pegs or hammers away day by day, thereby keeping his family in fashionable attire, and walking on carpets, that the bold, unflinching pioneer is sweeping the continent for a civilization broader and nobler than the sickly, aristocratic, and showy sentimentalism of New England; and though our children may not stand at the head of their class, learn to dance or play a piano, nevertheless they are learning that privations and hardships beget true self-reliance, which, in connection with simplicity of habit and honesty of purpose, constitute the only sure basis of a pure democratic government. The girls may not learn all the pretty manners of a boarding-school miss, yet we hope they will, soon after learning the alphabet, learn that industry, sobriety, and plain practical common sense are the rounds in the ladder of future prosperity. Our children may not attend church regularly on Sunday, yet we hope they will find truth and divinity in the bounties and beauties of nature around them, and extract enough living daily inspiration from each newly discovered variety of prairie flower to teach them that all preaching calculated to purify their aspiring souls, and rid them of the catechisms and dogmatisms of written creeds, comes not from human lips.

Say, then, to the Springfield mechanic, and to all others toiling in those overcrowded villages and cities, come to the heart of the continent and help to make farms, towns, cities, and States, and lay the founda-

tions for a government that shall belt the globe with its electrical element of "liberty, equality, and fraternity," purifying those oriental nations, by purging them of that effete, rotten aristocracy and hereditary miasmatic pollution of class and clan despotism.

Suppose you exchange a part of your brain for muscle, your death-producing pastry for healthful corn bread, your scrofulous consumption for the shakes, your church for God's temple, which is finer and more beautiful than Solomon's, your schools for new conditions and experiences which the degenerating sons and daughters of New England are dying for, your fashionable follies and fineries for the stern yet not always unpleasant duties of preparing a bright opening and future for your children, I can but think that they will rise up in the future and call you blessed for the rich inheritance of a home in the rich valleys or on the beautiful highlands of Kansas.

HOMES IN MICHIGAN.

A communication was received from Mr. H. P. Barker, of Traverse City, Michigan, detailing the agricultural advantages of that part of Michigan known as Grand Traverse. It has, he says, remarkable attraction in climate, produced by the vicinity of great bodies of water, which is seldom or never frozen. The soil abounds in lime, which makes it a good wheat region.

It has been demonstrated that on the level, wet, heavy clay soils of Ohio and other states, sheep sicken and die in such numbers that everywhere in these sections farmers are disposing of their sheep without regard to cost. Here, with our rolling surface, porous and dry subsoil, with pure water, wool growing will soon become a leading branch of industry. Raising wheat is a very profitable branch of farming. Winter wheat is most relied on, although spring wheat usually does well. Both in quantity of yield and in quality the Grand Traverse winter wheat is without rival. All kinds of garden vegetables are grown to perfection and in abundance. Rutabagas are extensively grown as food for cattle. They can be grown at a cost of three dollars per ton. Fruit growing is receiving considerable attention, and thus far has been successful. Apples, peaches, pears, plums, cherries, grapes, of all varieties, and particularly small fruits are seldom injured by cold or frost. That part known as the Peninsular, extending from Traverse City, twenty miles north, and varying from one to four miles in width, dividing Grand Traverse Bay into the east and west arms, is peculiarly adapted to fruit grow-

ing; and in a few years will undoubtedly be cut up into small fruit farms, held at enormous prices, and covered with fruit trees and vines. On this Peninsular we find the oldest improvements in the country. We have a number of farms on it of different sizes, and with good improvements, which we offer at fifteen to thirty dollars per acre." Adjourned.

June 2, 1868.

Mr. Nathan C. Ely, in the chair; Mr. John W. Chambers, Secretary.

PLANTING TREES.

Mr. George J. Knight, Brownville, N. Y., sent a long letter in favor of seedling apple trees, as they are longer lived and hardier than grafted trees.

Mr. A. S. Fuller.—I think the gentleman means well, but I say, as I have said before, that no man can afford to wait for seedlings to grow. My father planted seedling trees, and his boys had to steal apples from the neighbors, or go without. I advise every man to make experiments, for it is only by so doing that we progress. Though there are swindlers among nurserymen, still there are a plenty of honest dealers. One reason why so many trees die is because farmers are not willing to pay for packing. It often costs more to pack a large tree than it is sold for. A tree can be packed so as to be carried to any part of the world. But some discretion and sense must be used in transplanting. The ground must be prepared by thorough and deep culture. A part of the root should be cut, and also a corresponding number of the limbs. In these fast times we cannot wait to grow apple trees from the seed; it takes too long. As well think of going to Boston or St. Louis by stage coach. But if a farmer buys a few dozen trees, and when they come digs a little hole and sticks the roots in, giving no care and showing no skill, he will get no orchard.

Mr. W. S. Carpenter.—I remember some years ago a nurseryman in Erie offered a great number of young apple trees very cheap. I took several thousand of them at six cents each, and sold them out at ten cents apiece. Specific directions were given with each lot sold, and I had the pleasure of knowing that in most cases every tree lived and grew. To one I sold two hundred and fifty. He told me that of that number he lost but one. An apple tree should be two or three years old when transplanted, the top should be cut, and also

one-third of the root. If hot and dry weather succeeds, mulch with weeds or coarse grass.

Mr. A. S. Fuller.—Do you recommend watering young trees when first transplanted?

Mr. W. S. Carpenter.—No; as a rule it does no good except to pour some water into the hole, and not much of that. Mulching is a far better mode of keeping the earth around the roots of the young tree moist. That is nature's method.

DEFENSE OF PEDDLERS.

Mr. H. S. Holcomb, Neponset, Bureau county, Ill.—In reply to the onslaught made by the club on peddlers, I wish to say a word: Peddlers are as necessary a spoke in the great wheel of society as any other class. In States where but few tree peddlers have been, fruit is scarce and poor. In new countries they do much toward introducing articles which every family needs. Oily-tongued men are not wholly confined to the peddlers, still, when a man buys he must keep a sharp lookout.

Mr. W. S. Carpenter.—It often happens that trees die because the farmer plants too deep. As a general thing trees packed as nurserymen pack them will go safely to any part of the country.

Mr. Wm. Lawton.—In planting, if water is to be used, it should be poured into the holes before the trees are set and dirt placed on top, and not around them, immediately after planting, for then the ground will pack.

CIDER APPLES.

Mr. J. B. Lyman read a letter of inquiry from a correspondent in New Hampshire, asking what apple to plant in order to get the best of cider and the most of it.

Mr. Crowell mentioned the Harrison and the Canfield as the best of all our cider apples. Mr. Lawton and Mr. Carpenter recommended the Poughkeepsie russet as giving cider of fine flavor. As much as a dollar a bushel has been giving for this apple for making first class cider. The chair expressed the opinion that we cannot recommend the Harrison and Canfield unless we know whether they do well in New Hampshire. They grow and produce well in New Jersey, but for New Hampshire they may not be so well suited as the russet. He would recommend obtaining his trees from some New England nursery, and to take the testimony of his neighbors as to the best variety for his locality.

South Carolina.

Mr. G. W. Faset, Anderson, S. C.—This is one of the upper districts of South Carolina, close under a brow of the Blue Ridge. The air is pure and healthful, and the fever and ague is unknown. I know of two or three northern families who came hither about ten years ago, and have enjoyed good health ever since. The water is soft and abundant. Our lands only need northern men to introduce their improved mode of cultivation, and show our people what can be done. Wheat, corn, potatoes, and cotton are the principal crops, and they pay even under our poor system of farming. Water power is abundant. The terminus of the Greenville and Columbia railroad is at the county site, as well as the terminus of the Blue Ridge railroad from Knoxville, Tennesse, which is completed to Walhalla, some forty miles beyond Anderson. All who contemplate moving should visit the mountain district of South Carolina. Land is cheap, and every man, woman and child will find a hearty welcome.

Early Fruits and Vegetables from Delaware.

Mr. Henry T. Williams, New York.—I want to call public attention to the great success which is attending fruit culture in the above State.

The "*little fruit State*," as she is sometimes called, possesses a wonderful capacity for raising every description of berry, fruit or vegetable, not only excelling all other States in abundance, but beauty, size, vigor, taste, earliness and freedom from disease, to an extent little known or appreciated by those who have paid no attention to the subject.

The distinguishing features of Delaware are the warm, rich soil, and the early season. A large portion of it is from one week to ten days earlier than New Jersey, and, in the southern portions of the peninsula, some crops are harvested two weeks or more before they ripen at Philadelphia. To a gardener or fruit grower an advantage of this kind is worth thousands of dollars.

Sooner or later the entire peninsula must become the great fruit and vegetable garden for early products for New York and northern markets, and there are many excellent opportunities for those who like a life among fruits and flowers.

I will give you a few instances of success.

Apple trees thrive as if they knew or desired no more favorable locality. Nothing can exceed the beauty of the trees, their healthiness,

freedom from disease, vigor of growth and production. Trees yield here from one to two years earlier than further north, and for early summer apples the prices received are almost fabulous. From a seven year old apple tree seven dollars worth have been taken, and from a twelve year old one, thirty dollars have been realized. Large orchards are exceedingly profitable.

Pear trees yield early and in perfect luxuriance; all kinds succeed to admiration, and are troubled with no disease, worms or leaf-blight whatever.

An orchard of 400 dwarf pear trees only four years old, averaged, last fall, one basket per tree; and from one tree three baskets; all were sent to New York, and averaged six dollars per basket, or $2,400 for the entire acre. Two pear trees at Milford yielded the owner fifty-six dollars.

Peaches, which form the largest orchard product of the State, are exceedingly profitable, whether grown on small or large farms. Some idea of the magnitude of this production can be gained from the fact that last year the entire crop sent to market by railroad and water communication, reached the figures of 1,108,000 baskets by railroad, and 750,000 by water.

James Fennimore, of Newcastle county, sold from an orchard of one hundred acres (10,000 trees), in four consecutive years, $87,000 worth of peaches. This is a positive fact. Another case is true, where an orchard of less than 2,000 trees, yielded in one season $4,000 net profit.

Another near Dover, which I myself saw in crop time, yields from seventy acres, a profit of $10,000 yearly; the purchasers buying the crop on the trees.

There are other instances where a place of forty acres yields $2,000 per year; one of three and a half acres yields $500 per year; one of five acres $1,300; one of twenty acres yielding fruit to the amount of $4,300 annually, and one of five acres also, where the income from the peaches is greater than from the rest of the entire farm of 350 acres.

At Milford, between $8,000 and $9,000 have been cleared in three seasons, from $2,500 trees.

Orchards in the two lower counties, range from 5,000 to 20,000 trees, and one gentleman in Sussex county, put out 60,000 the last season. It is generally estimated that peaches will average at least one dollar per tree profit.

Strawberries and all kinds of berries, promise to be a most prolific and profitable crop. Last spring, strawberries shipped in small quantities to New York, brought one dollar and twenty-five cents and one dollar per quart; the price gradually declined to seventy-five cents, then fifty cents; and forty cents was the lowest price obtained, the last berries bringing the same price which the earliest from Hammonton obtained.

From one-third of an acre at Dover, there were sold, net, the handsome little value of $680. Three acres yielded $2,000 over all expenses; four acres at Smyrna, brought $4,000, the purchaser doing his own picking. At Milford, four and a half acres yielded one year $2,800; another $3,000.

The secret of these prices is in *their good condition*. Pickers can pick till three or five P. M., put their fruit on an express train, and it is in Washington market before six the next morning, sweet, fresh and uninjured. It is safe to say, for a series of years to come, twenty-five cents per quart will be as low as prices will go. With good cultivation, $500 and $1,000 per acre will be common results for Delaware.

Currants and gooseberries have not been tried on a large scale, but they thrive splendidly wherever grown in gardens. I think either will be a success, and give munificent returns.

Cherries are exceedingly early. From a single young Morello eight dollars worth have been taken. No disease has yet afflicted this tree here.

Apricots and plums will pay to raise and hire a man to do nothing else but pick over the trees every day to keep them free from disease or insects.

Mr. James Lord, of Camden, in 1867, had a small apricot tree about six years old, that bore four bushels of apricots. The first bushel was sent to a commission merchant of New York, who gave him one dollar per quart. Had the entire fruit been carefully picked and marketed, the tree would have yielded $128.

The Concord and Hartford Prolific are the only grapes that will succeed. All others are failures.

Extraordinary results are accomplished in *vegetables*. One grower told the writer that from three-fourths of an acre, *without manure*, he had taken 275 bushels of Irish potatoes. Another planted Irish potatoes after spring frosts, gathered the ripe tubers in June, planted

the same ground to cabbage, and gathered the crop before frost came again in the fall.

Sweet potatoes yield 300 bushels, or 100 barrels and upward per acre. Early potatoes bring one dollar to one dollar and a half per bushel, and there are many farmers who clear every year the value of the land devoted to potatoes.

We saw one farm of 200 acres, leased with buildings on the half-share plan, which netted to the tenant over his expenses, for his own portion, the good sum of $10,000 ; and the produce was solely grass, corn, potatoes and wheat.

TOMATOES.

At St. George's a grower sent to New York and Boston the tomatoes raised from an acre of ground, and the net result was $700. One grower near Dover realized $400 per acre, for tomatoes sold at twenty-five cents per basket to the canning establishment; the tomatoes were described as being so thick that it was impossible to pass over the ground without stepping on them. A case occurred at Camden, of a man who cultivated one and a half acres on half shares with the owner. The tomatoes were sold for twenty-five cents per basket, and at the end of the season he handed the owner $275, or $100 more than the land was worth. Such results are remarkable, but are not safe enough to form estimates upon for large culture; 400 to 500 bushels can be considered a good yield per acre. The first shipments realize perhaps five dollars per crate, then the price falls steadily to one dollar, and the majority over fifty cents.

Beets have been exhibited at an agricultural fair weighing fourteen pounds, and four filled a bushel basket. One thousand bushels of corn have been raised from fifteen acres; one acre eighty-eight bushels—one hill, two stalks, together containing eleven ears.

There is no reason why, by the same energy as the Bergen truck-growers, all kinds of vegetables may not be grown in Delaware, and successfully supply New York two weeks earlier than they now do. Rhubarb and asparagus will pay finely. Cucumbers, beets, lettuce, spinach, cabbages, cauliflowers, egg plant, onions, all will do well.

Railroad transportation is easy and quick, and rates are fair. I can hardly see what there is to prevent the State from rising from her position as one of the smallest in the Union, to one where she can claim eminence on account of her wealth and successful fruit and garden cultivation.

1776 and 1868.

Dr. J. V. C. Smith made some interesting remarks on the modern farmer's family, as compared with that of the last century, and concluded by reading the following contrast; the first lines by Dr. Franklin.

1776.

"Farmer at the plow,
Wife milking cow,
Daughter spinning yarn,
Son threshing in the barn,
All happy to a charm."

1868.

Farmer gone to see a show,
Daughter at the piano,
Madame gaily dressed in satin,
All the boys learning Latin,
With a mortgage on the farm.

Oil for Manure.

Mr. John Yeend, Claridon, Geauga county, Ohio.—Break twelve pounds potash into pieces, mixed with four gallons of water; let it stand forty-eight hours, then add fourteen gallons of oil. In a few days add fourteen bushels of sand, or twenty of dry mold; mix with fresh horse manure to bring to a heat; turn frequently to prevent fermentation, and in six months it will be fit for use.

Mr. J. D. Lyman.—Does the oil do any good? There is no proof that it does. The potash, salt and water, mixed and stiffened with dry garden loam and horse droppings, would make a fine manure of themselves. Mr. Lawes, of England, made full and faithful tests to ascertain whether oil has any fertilizing power, and his conclusion was that it has none. In making fish guano of moss-bunkers it is found that nothing valuable as manure is withdrawn by expressing the oil.

Enemies to the Strawberry Vine.

Mr. S. P. Meyrs, of Mifflinburg, Pa., asks the Club what mulch to apply to strawberry beds, and how to kill the worm that damages the vine?

Mr. A. S. Fuller.—This Club often exposes itself to attack in the country press by answering just such questions as this asked by Mr. Meyrs. It is easy to prescribe a good mulch. He may use grass, straw, coarse hay, or, what is a little better than either of these, half-

decayed forest leaves. But when he wishes us to prescribe for a worm he must give us more specific information. There are some twenty worms that do more or less harm to the strawberry. Some attack the roots, others devour the leaves, others eat the berry, another stings the fruit, so it never comes to perfection. A little salt may drive one enemy. Wood-ashes will repel a certain kind of grub, but it would be unsafe for us, without knowing more of the mischief to prescribe either salt or wood-ashes to Mr. M. He could easily kill his vines by a too free application of either.

CALIFORNIA.

Mr. Wm. C. Blackwood, Haywood, Alameda county, Cal.—Mr. Woodhouse wrote about our State to the club, which was reprinted in one of our local journals here, and the false impression should be confuted. I have been here sixteen years, and am a farmer. I have twice revisited the Atlantic States, and after a careful survey of all the various industries I give a decided preference for California. It is true we are taxed two or three per cent on valuation, but the valuation is low. For instance, I bought a farm for $2,700, and the tax was $14.81. It is equally true that the crops are injured some years for want of winter rains, but there are failures from other causes elsewhere. Rust and mildew here are unknown. During the few seasons before the wet one of 1862 the valleys of Santa Clara and San Joacan suffered more than other portions, owing to the courses of the mountain ranges, attracting or repelling the clouds; but there was no failure in counties removed from these influences. For ten years the crops of wheat and barley of California exceed those of any other State by at least twenty per cent. The English walnut is a magnificent tree, bears eight years from planting, and its first crop is about fifty pounds of dried fruit. Los Angelos, celebrated for oranges and other fruits, has many orange groves coming into bearing, and they sell in the orchard at thirty-five dollars per thousand. Vast quantities of land, every way excellent for fruit, can be had as low as $125 an acre. Mr. Woodhouse speaks of the great cost of lumber and fencing, but the same is to be said of the western praries; while the winters there are terribly severe. For one to begin with advantage he should have his land paid for, and $2,000 beside to build a small house and to buy farm implements, teams, &c. Industry and economy will do the rest.

LOUISIANA.

Mr. S. S. Connor, Amite City, La.—The proceedings of your body awaken an interest and exert an influence throughout the length and breadth of our country; and there is no single feature in connection with it of more general interest, perhaps, than the short correspondence published descriptive of every locality throughout our wide domain. Thousands of persons north and east, as well as in Europe, are desirous of removing to more favored regions, and hence look with eager interest to every source of information. For the benefit of such, I beg to add a few words in behalf of this section. And as there are so many doubters everywhere, I will premise with the statement that I am fully prepared to substantiate, for the benefit of any private individual who may choose to correspond with me, the truth of all I write. This place is sixty-eight miles by railroad, above New Orleans. For fine climate, good health, and beautiful streams, it is unsurpassed by any locality in the south. It is not so fertile as many other portions of this rich State; but for fruits it seems especially adapted. Peaches grow ten or eleven inches in circumference, and of most luscious flavor. Horticulture is in its infancy here; but I will state what may be seen on the grounds of Mr. Alsworth, President of our agricultural and horticultural society. Tired of cotton, he and a few others of us have turned our attention to grape-growing. Concord grape-cuttings made an aggregate growth of forty and fifty feet of vine last summer, while those grafted on the wild vine attained over 100 feet. Some of the cuttings now have more than thirty bushels of grapes and grafts seventy or eighty. We expect to realize from fifty cents to one dollar per pound in the New Orleans market, which will give a handsome profit within one year and a half from the time the cuttings were stuck in the ground. These cuttings were obtained from Missouri, and are the first of the Concord variety I ever saw. I obtained some Jucunda strawberry plants from Mr. Knox, of Pittsburgh, and set them out in the latter part of December, and on the last of March was marketing fine berries from the same. We have no epidemics here, nor any sort of climatic fevers, not even the ague, except rarely. Musquetos are not troublesome more than two or three weeks in the year. We want to see our resources developed, and intelligent, enterprising immigrants from any and every part of the globe would be welcomed.

SOWING GOOD SEED.

Prof. Nutting, Randolph.—"As ye sow so shall ye reap," was never more true than to-day. Crop after crop having been taken from our fields without sufficient application of manure, the elements of fertility become partially exhausted, and we cannot afford to have those elements still remaining consumed by the growth of weeds or poor grain. Some think that Providence put weed seeds in the ground at the creation, and man can never get them out; but it is certain that he has got many kinds out in some localities, and whether it is interfering with the Creator's plans it has proved a great benefit. Every weed that grows in our wheat is a boarder consuming food which it has not earned, and will never pay for. Why is it that the corn crop is as good now in all parts of the country as ever? In those parts of New England it has been better for the last ten years, and the quality is fully as good now as it ever was, but this is not true of other grain. I think this is because more care has been taken in saving and preparing the seed for our cornfields, or rather because we have been able to select the largest, earliest ripened, and plumpest kernels for seed.

FARMING ON LONG ISLAND.

The following from Mr. J. E. Buckingham, of Manorville, Long Island, shows what courage and good sense can do on what are called "the Barrens."

"My farm is situated four miles from the Long Island Railroad, south of Manor Station, on a level track of scrub land, the soil is two and a half feet of loam, then comes gravel and sand. I have cleared it all up with the stubbing hoe, say about ten acres, and manured with barn-yard manure and seaweed which I haul from the South Bay, which is one and a half miles to the south of my place. I clear off one acre or more, as circumstances permit, put on a light coat of manure that I get from my yard and hog-pen and spread it on the ground and plough it under for corn. I get about sixty bushels of ears to the acre the first crop. In the fall I take the corn off, plow the ground, sow one-half ton of fish guano, one car load of ashes (of 140 bushels) to the acre, and seed down with wheat, and have never failed but once in six years in raising thirty bushels to the acre of wheat. In 1865, when the wheat crop was a failure by being shrunk, my wheat was complete. I sowed the white wheat. I could have commanded the premium at the Suffolk county fair. I sold it all for

seed wheat. I raised twenty and one-half bushels on one acre. The object of my writing to you is to suggest that there are so many in our country with small means that could get a living and a good home with a small capital here. I can purchase 500 acres of this land for five dollars per acre. A good team will tear the scrubs out by the roots. Fires have destroyed the timber, so one has to encounter no timber stumps, and needs no patent stump-pullers. It can be cleared for twenty-five dollars per acre, and then you will have about as good land as there is east of the lakes for corn, wheat or grass. Why will men buy old worn out farms for twenty dollars an acre when for five dollars they can get land just as well situated, fresh and good, that will give (what no old land will) thirty bushels of wheat to the acre?"

Rust on Melon Vines.

Mr. Wells C. Norton, of New Market, N. H., asks, by letter, what will prevent rust on his melon vines, and what manure to use on them.

Mr. S. E. Todd.—Let him stir wood-ashes into the earth around each hill, and mix a little salt with the ashes. The manure for melons should be fine and well rolled, also thoroughly mixed with the earth in the hill. Squashes and cucumbers will thrive on gross and cruel substances, but melons are more delicate feeders.

Spear's Preparation for Preserving Fruit.

The committee to whom was referred Mr. L. H. Spear's preparation for preserving fruits, respectfully reports:

That since the action of the Club last year, in relation to the same subject, Mr. Spear has modified his preparation by adding another ingredient which he claims has obviated an objection to the compound as first used, arising from its partial decomposition after a considerable lapse of time. Several members of your committee have examined specimens of fruit preserved by the improved process. Some of these retained considerable of the original flavor of the fruit, while others had entirely lost it, yet without undergoing fermentation. This last preparation, sold under the name of "The American Fruit Preserving Powders," has not been tested for a sufficient length of time to enable your committee to decide definitely upon its value.

The new ingredient used contains an element which, although inert, does not enter into the composition of the human body. While your

committee desires to be very cautious in recommending the addition to condiments of any article not known to be nutritious, or the continued use of which would excite abnormal action in the human system, still it is disposed to approbate Mr. Spears' efforts in the hope that he may yet satisfactorily accomplish what seems to be a very difficult task, that of discovering a solution which, when applied to fruits and vegetables, will prevent their fermentation and decay, without destroying their peculiar flavor and those aromatic and savory qualities found only in the ripe offspring of the plant.

S. D. TILLMAN,
JOSEPH B. LYMAN,
J. V. C. SMITH,
Committee.

The report was accepted and placed on file.

Adjourned.

June 9, 1868.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Cut-Worms.

Mr. R. R. Bascom, Greensbury, Ohio, asks how can we get rid of cut-worms?

Mr. A. S. Fuller.—Ever since I commenced keeping crows I have not been troubled with cut-worms. I have a tame crow that will destroy more cut-worms than six men, and when he eats all he wants, he kills them for the fun of the thing. Crows are as easily tamed as hens. One morning I counted 100 rose-bugs that my crow ate for his breakfast. I would keep a dozen of them if the neighbors were not so prejudiced. My crow will hunt worms by turning over leaves and lumps of dirt, the same as a man. One undertook to go to town with me one day, but he came across a man with a gun, who shot him.

The Chair.—I once had a crow that would fly into my neighbors' windows, and come back with silver plate, breastpins, watches, and all kinds of jewelry. Of course I had to dispose of him.

Mr. Isaac P. Trimble.—Crows are of great use, for they kill myriads of grasshoppers and cock-chafers, which destroy timothy grass. The crow and the rook are the most intelligent of all birds. They know by the looks of grass when worms are working at the roots.

Mr. T. C. Peters.—He is the most useful bird on the farm. I have

never known a crow to destroy birds nests, and it is a great fallacy to say that he destroys corn. I always make a bargain with him in the spring, to give him all the corn he will eat if he will let the planted alone. They dig worms all the while, and the complaints farmers make about insects will increase, if they continue to kill the crow. Skunks are also most useful in destroying beetles. In Schoharie county they cannot raise hops except by the help of these animals, and the farmers value them as much as their cows. Crows pull up corn when worms are in the hill, but they never eat it unless they are starved. A peck of corn will save ten acres.

Mr. Isaac P. Trimble.—They do pull up corn, but it is to get that which is soft for their young. Hard corn they will not touch.

Mr. Wm. Lawton.—Building large poultry yards is absurd. If poultry is fed on cracked corn they will not destroy anything in the garden but insects.

Glauber Salt as a Fertilizer.

Mr. George E. White, of New York city, sent several boxes of Glauber salt, which were given to various members of the Club, to be used on cabbages and turnips. It is said to be an effective manure, applied in small quantities to young plants, not more than a table-spoonful being used on one cabbage-plant. The gentlemen who took the boxes will use and report result. If found a useful application, it may be of much use to the farmer, as it can be had for thirty-five dollars a ton by the quantity, or two cents a pound in small parcels.

Mr. A. Preterre.—The chemical name is sulphate of sodium. It can do no harm in small quantities; and in certain soils, and for special crops, should, from its composition, be a useful application.

Florida.

Mr. T. C. Peters spoke as follows, on the attractions of that tropical State:

"My remarks here two weeks ago seem not to have been properly understood, or rather, they were so brief that something more may be proper on this occasion. Sugar-cane is quite as easy of cultivation in Florida as Indian corn at the north. The cane has to be renewed in some localities once in three or four years, in others only in seven years. It is very productive. Almost every farmer has his 'cane patch.' Before the war, some as large as fifty acres. Usually from

half an acre up. A man who knows how to make maple sugar can make cane sugar and syrup, and the process is not more expensive. The yield from an acre varies from 300 gallons of syrup and two barrels sugar, to 800 gallons and five or six barrels sugar to the acre according to the condition of the land. The syrup has a ready sale at Savannah, and other large towns, for from fifty cents to seventy-five cents per gallon. Long staple cotton is also a favorite article of cultivation, and when well handled is very profitable. Choice samples often bring from ninety cents to one dollar and twenty-five cents per pound, and no fear of competition to reduce the price. A crop of early Irish potatoes is easily grown and can be planted successfully in the forest, so that the emigrant need not wait to clear the land before making a crop. Along the line of the Florida railroad the first crop, if well managed, will net $100 per acre. The transportation from Fernandina is regular and sure. Also from points along the St. John and Ochlawaha, where there are large tracts of fine land to be had almost for asking

"I would not advise northern emigrants to go, earlier than October. As Mr. Robinson said, people must prepare for a new country, but one that can easily be subdued and made habitable, vastly superior to the far off west, into which people are now rushing in such numbers. Mr. Peters then read from a private letter, received from a planter in Alachua county, dated May 23: 'Thus far my crops are fine. I suppose you will be somewhat surprised to hear that the farmers have all laid by their corn crops in this section. My corn is now in full silk and tassel. My cotton is beautiful and has a great many blooms.' He rolled his cotton seed in a fertilizer, and made a roller go over the seed for nearly one hundred acres. The seed was well moistened before rolling. Great good resulted in the early germinating. Speaking of the orange grove which they were just planting among the newly fallen trees, when I was there, in February, he says: 'Brother is hard to work. He has planted four hundred trees. Out of the number, only four died. He has budded a great many with the China or sweet orange buds, which are growing finely. Some are now two feet in length. If they continue as well we shall have China oranges ready for the market in three years. We expect to plant during the year about one thousand buds, which will keep brother busy treding. The forty acre lot which you saw, we intend to plant out to orange trees before we stop, which will give us an orchard of 4,000. If we are successful, and thus far I see nothing

discouraging, we shall have a fortune in a few years. We have planted a good many bananas. They are growing finely, and in two years we shall have the fruit for market. We intend to have most of the tropical fruits in our grove as soon as we can get them."

N. C. Meeker.—I don't see why we should hold up Florida so constantly as the best place in the world for the poor man who wants a pleasant home. The State is an old one, but it has never attracted population, and there must be something about it that we haven't heard of yet. Why all the people in Florida would not make so big a town as Leavenworth. Either the land is miserably poor or the society is bad, or the climate sickly, or there would be more people go there.

Cows for the South.

Mr. William M. Matthews, who lives in Georgia, near the Florida line, inquires about a milch cow, how to get her to Savannah, and what kind to buy, and how much milk he ought to expect of a good cow, and her cost here.

Mr. J. B. Lyman.—The best breed for milk only is the Ayrshire; the best for butter is the Alderney; the best for size and beef is the shorthorn. Any northern cow would need to be acclimated, and would not do well at first so far south. She should be kept in a cool open shed and fed on green forage and protected from musquitoes, if possible. The cost of a first class cow is from seventy-five dollars to $150, according to breed. But the advice of the Club to Mr. Matthews is to import a good Ayrshire bull calf that he can get for $100 or $150, and buy the best native milkers he can find in his part of Georgia. In a few years he will have a herd of very valuable cows. Meantime, Mr. Fuller suggests the use of Borden's condensed milk.

Longevity and Intelligence of Animals.

Mr. J. V. C. Smith read the following interesting paper: With a considerable degree of accuracy, naturalists have determined the ages of horses, oxen, sheep, goats, asses, mules, cats, dogs, and many others, so long ago that it would be difficult to refer to those who are entitled to the most distinction for their industrious researches in that relation; and, further, experience of ages has proven the fact that their lives cannot be much prolonged beyond the ordinary limit assigned by the laws of nature, with the utmost effort of human ingenuity.

Among men there are individuals whose vital strength carries them further forward in age than others. It is not so frequently the case, however, with the lower animals. Occasionally horses have attained fifty or sixty years. But such instances are extremely rare, and depend more on some original endowment in their organization than from any particular care bestowed upon them with a view to their greater longevity. A white mule in Virginia, belonging to Gen. Leighton, was eighty-five years old; it lived through three generations, and knew more about the work on the plantation than anybody else.

Dogs cannot be kept alive much more than twenty years in any tolerable condition of health. Their vigor wanes; vision becomes exceedingly imperfect, and although the sense of smell is the last of the special senses to fail, if it ever does before death, they are reluctant to move from comfortable quarters, where they sleep most of the time. Dogs understand several languages, such as French, Italian and Spanish. A dog on Fifth avenue, in this city, understands only Italian. It is related of a yoke of oxen being killed in crossing a railroad, because one of them was French and did not understand his English driver. Poultry understand no language disconnected from feeding. Fish will come to feed at the ringing of a dinner bell.

When the domestic animals become aged, which, with some of them, may be at twenty or thirty years, they loose flesh and strength. It is almost impossible to fatten them thus, as the food seems to be imperfectly digested. At least, nutrition is defective, and gradually they have a lethargic appearance, and finally die without the indications of disease. This is a decay of life with them. In all the intermediate periods between youth and middle age, they may fall victims to infectious maladies, injuries from combats, or excess in gorging themselves after protracted fasts. No other excesses can be laid to the charge of dumb beasts, as they are controlled in other respects by instincts and by times and seasons which do not reduce their physical energies. They violate no laws of organic life, without the exercise of reason, that intellectual man does with all the consequences before him, and reason for a guide.

With this accumulated knowledge respecting animals intimately associated with man, which has the merit of being pretty accurate, it is rather surprising that more exact data have not been established in regard to man himself. If the greatest study of mankind, in Pope's day, was man it is no less so now, when institutions have

grown into public favor that ought to be able to decide upon the probable limits of life with more certainty than has hitherto characterized tables of expectancy, probable longevity, and some other guesswork assumptions in the department of vital statistics.

With the records of centuries, and the collected observations of careful students who have earnestly interrogated nature with a hope of ascertaining how she gauges the lives of males and females, and by what signs the secret may be brought to light, that will invariably point to the positive day of death, it is still too much left to conjecture and theoretical speculating.

By referring to Goldsmith's Natural History, a work quite obsolete and perhaps out of print, but which, nevertheless abounds with curious statements, a pretty correct mortuary table may be found which chronicles the life-period of animals with which we are not familiar. It is quite evident, in the very constitution of things, long life was never intended for those which multiply rapidly and mature in one, two, or three years. Were they to exist as long as man, the surface of the earth would not accommodate the irresponsible myriads, nor food be produced in sufficient abundance to meet their necessities. It is, therefore, in accordance with a Divine arrangement, which contemplates the greatest amount of happiness for all, that a law of limitation fixes unalterable boundaries for life in all races, types, and forms of organized beings. To this decree man must submit. With such facts before us—and they have been recognized by learned naturalists for ages—it is strange indeed that it has not yet been ascertained to what length of life our own race may attain. Thomas Parr married at eighty for the first time, and lived to 152 years—left a grandson who died at 124. This demonstrates an actual transmission of vitality; but Henry Jenkins—a still more remarkable example of longevity in modern times—reached the patriarchal age of 169. But this by no means determines the duration of human life. It seems to have been a received opinion in the time of King David that seventy years was the ordinary measure of human existence. Any years beyond are poetically represented as unsatisfactory and burdened with infirmities. The difference, therefore, between the ages of the patriarchs of the Jewish nation and of men in the most flourishing period of Jewish nationalty was very striking. Moses died at 110, and his natural forces, says the chronicle, were not abated. Hufeland believed the duration of human life might be about 200 years. With an experience of 6,000 years—the problem is an unsolved one—it has not been determined how long we could live.

We have settled the question respecting the length of life, with domestic animals associated with man. Their days are specifically limited. They are quickly developed, and almost as rapidly fall into decay. Man's mission and ultimate destiny are so widely different, the laws governing his organic structure operate in conformity to a higher nature; the corporal lasts longer, that his intellect may be exercised for directing and controlling the mineral, vegetable and animal kingdoms, he being truly lord of all he surveys.

Woodward's Fountain Washer and Boiler.

Mr. Edward F. Woodward exhibited in active operation his fountain washer and boiler, which took the highest premium at the Fair of the American Institute, in 1863. This remarkable contrivance is wholly self-acting: by applying heat to the bottom of the boiler, steam is generated, causing a rapid circulation of water or suds, and producing a continuous upward flow of boiling suds through the center tube, from which it is forcibly discharged, and spread over the suface of the clothes, thoroughly penetrating and percolating through every fibre on its return through the perforated circulator to the bottom of the boiler or lower reservoir. In this manner it most effectually cleanses the clothes from all impurities, *without labor* or annoyance of any kind.

Messrs. N. C. Meeker, S. E. Todd, and J. B. Lyman said they had this boiler in use in their families and find that it greatly shortens the labor of washing, and robs Monday of its terrors for the housewife.

Horse Hay-fork.

Mr. L. S. Mason, of Middlefield, N. Y., showed a harpoon fork for loading and unloading hay. It is a hollow car of steel sharpened in angles at the tip. When plunged into a pile of hay, a string is pulled by which spurs are made to come out and hold the harpoon so several hundred weight can be lifted by it. Mr. Wm. S. Carpenter spoke of it as superior, in his opinion, to any hay-fork in use, and he has tried nearly all the late patents.

Holly's Laundry Fork.

This was exhibited by Messrs. Peck & Seymour. It is of galvanized iron, with a wooden handle, and was highly commended.

Hand Corn and Seed Planter.

Williams & Merrick, Sebeck, Me. This instrument having been given to Mr. N. C. for trial, he states that it seems to work well, and to perform all that is claimed for it. It is easily adjusted for different seeds, and it adds to the expedition of planting. It is more suited to garden than field work, and the ground should be well prepared.

Opium.

Mr. G. G. Patterson, Brooklyn, California, inquires in what country the poppy is grown from which opium is made, and if there is any boiling or distillation used.

The Secretary.—The poppy (*papaver sommiferum*) originated in the east, but now is naturalized everywhere. It is grown extensively in Europe, often for extracting an oil from the seed which is next in value to olive oil. The finest opium is obtained by making incisions up and down in the green capsules in the evening; a milky juice flows out, it is suffered to remain till the following evening, to get sufficiently thick, which we understood to be opium itself.

Mr. George A. Dritz, Chambersburg, Pa., is evidently addicted to experimenting, and forwards the following communication concerning

Wheat.

The native and foreign varieties are doing remarkably well this season. The kinds that are taking the lead for hardiness, earliness and productiveness are the French white chaff, Mediterranean (all in head at present writing), the French red chaff, Mediterranean, Week's white, Lancaster red, Drihl's white, blue stem, white Hungarian, red American, white bearded, amber Mediterranean, German red, Hallet's English red and white, Rogers' red, Rochester red, Egyptian red, Tuscan amber, three years acclimated. Of the Tuscan red, one year sown, half was winter-killed, the remainder stooling wonderfully, almost covering the vacant ground. This heads late. The Tuscan white was all winter-killed; also, the California. We are buying these last two for spring sowing, but they do not promise well at present. I find that wheat received from California, Chili, Peru, and the southern part of Italy does not acclimate well in our wet and cold soils. I find that the varieties that do best come from France, Austria, Hungary and Prussia. These not only hold their own, but improve by cultivation in this country. They are mostly red and amber wheats, bearded, with a few exceptions. White, smooth and

bearded, as also English wheat, are not doing as well as I should like. They seem to want very rich ground to bring them to perfection. I have about fifteen varieties growing that I will give you an account of at another time. I will also make a report of an experiment I am making with Swedish, Norway, New Brunswick, and surprise oats.

CISTERNS.

Mr. J. F. Glosser, Altoona, Penn.—I wish to know the best mode of building a cistern that will insure pure water by filtration.

Mr. N. C.—Where the ground will permit, one should dig from fifteen to twenty feet deep and six or eight feet across, and catch the water in the winter, which will form a year's supply. A barrel filled will charcoal will answer for a filter, or if caught at the above season and during a long rain, taking care to let in only after the roof is well washed off, no filtering will be necessary. A cistern of this size is the best; if it were thirty feet deep it would be better, because, if half full, there would be a supply, and the water would be as cold as well water. Fifteen feet deep will require two barrels of cement put on the earth. A brick arch should be turned over the top. When one can dig only eight or ten feet deep on account of water coming in, two should be dug, one smaller for the filter; or there may be only one and a filter of charcoal and sand for the water to run through. The best way is to dig in a dry time, so as to go deep, and a wall of rough brick, cemented, may be built if the surface cannot be made smooth for putting on the cement. For cooking, for stock, and even for drinking, a cistern is better than most wells, and it does not generally cost so much. It should be cleaned out once a year, and there should be at least two. The roof that shelters stock during the winter will catch water enough to last the year round. The great defect of cisterns, as usually built, is their small capacity. It is not necessary to have a mason to do the work. Any man with a little ingenuity can build one for himself. To plaster on the earth it is necessary to dig the wall smooth. For one barrel of cement, use from two to three barrels of sand according to the strength of the cement, mix well and only about as fast as it is used. A trowel can be bought for one dollar and fifty cents, and thus, at a small expense, one can have a cistern as the result of his own labor. If it should leak, put on another coat. Mason's work does not always stand. We believe it a good deal better for a farmer and his boys to learn to do such jobs themselves than to depend upon others, even though

they may not get things right the first time. It is the making of boys to have them lead out in these independent ways; for not only will they be self-reliant and abundantly able to take care of themselves, but they will richly earn good victuals and clothes.

John M. Martin, of Minonk, Woodford county, Ill., writes sensibly of

Plowing on Flat Lands.

The rainy weather of the last few weeks makes all who are interested in the growing crops feel deeply the need of some way to carry off the surplus amount of water with which the ground is covered. Our land must be drained. But how? It takes long to underdrain and our crops must be growing. It is my experience that much can be effected by plowing properly. Out in the west it is the common practice of many farmers to plow around and around a field till it is finished. This is wrong, for when this is done year after year, makes the center lower than the outer edges, and thus a sort of basin is formed which will hold the water. Before starting to plow, a man should examine his ground, and find which way the water drains naturally, and then plow accordingly. Plow in narrow lands thowing out deep middle furrows which will act as ditches. Never plow across the end of lands, but let the furrows extend the whole length. This mode of plowing I have adopted from experience, and I believe nearly double the amount of grain would be raised in Illinois if farmers were to plow in this manner, and attend to plowing deep. Land plowed in this manner is fit to be worked a week sooner than that plowed in the old way.

John W. Chambers submitted the following report of the

Flour Seed Distribution.

The Secretary of the Farmers' Club reports that since the 15th day of November he has received 15,328 applications for seeds; these were from nearly every State in the Union; and that he has sent out by mail over 90,000 papers of seeds. The labor of putting up the seed has been immense. An assistant has been engaged over three months at this business. The club is indebted for these seeds to a great many persons who wished to aid this cause. Among the principal he would mention Mr. Wm. R. Prince, of Flushing, L. I., who furnished more than twenty-seven varieties; the Rev. Samuel Griswold, Saybrook, Connecticut, sent 5,000 packages; Edward Gillett, Southwick, Maine; G. F. Edred, Pennsylvania; Lewis Brey, Indiana;

Bruce S. Hoag, A. G. Bisbee, Ohio, and to a large number of ladies, the list too long for publication.

Adjourned.

June 16, 1868.

Mr. NATHAN C. ELY in the Chair; Mr. JOHN W. CHAMBERS, Secretary.

COAL-TAR FOR PRESERVING WOOD.

Mr. Samuel T. Rodgers, Waterbury, Ct.—For fence posts the bark should be removed, and a thick coating of coal-tar applied. Every farmer should have a barrel of this valuable preservative on hand.

Mr. Colyer.—In laying the Nicolson pavement one-third pitch and two-thirds coal-tar are used. It is much better to dip the posts in a vessel of hot tar than to apply with a brush, which will not stand the tar. Any common oil is good for cleaning the tar from the hands; afterward kerosene may be used to finish up with. A good deal of the coal-tar from gas-houses contains an acid which is sometimes injurious to pine wood. The Dunderberg was seriously damaged by the gas-house tar used in its construction.

DEEP PLOWING.

Mr. David Pettit, Salem, New Jersey.—We do not plow in this county six inches deep, and yet our crops have increased rapidly for the last thirty years, so that our productions are now more than double what they were then, and our farm lands have advanced in market value in a much greater ratio. None of our best grain farms can be purchased now for $200 per acre. This, too, under a system of plowing rather under than over five inches.

Your reporter says: H. Greeley decidedly said that a farmer should start with eighteen inches of *fertile* soil as a capital, and expressly disclaimed advocating turning up barren subsoil to the surface. If H. G. means that we should pulverize and manure our land to the depth of eighteen inches before cropping, or even after, the idea to practical farmers here is simply ridiculous; for no land here will pay in farm crops the extra cost of manuring and pulverizing to that depth, or the half of it, if our crops should be largely increased thereby; but all experiments here of deep plowing and subsoiling to increase our crops have proved failures and been abandoned.

Of what possible use can it be to resort to deep plowing and pulverizing to increase our crops, if it would so increase them when we grow crops already larger than they can stand and mature under the

shallow and cheap system of plowing. The advocates of deep plowing say, it will prevent our crops from suffering with the drouth by enabling the roots of plants to penetrate deeper to find *food* and moisture. Is this true? *Do* the roots of our *grain* crops penetrate to the depth of nine inches, a foot, or eighteen inches, or more? What evidence of it is there? Who has shown that the roots of our grain crops do so penetrate where the soil has been deepened? Go into a cornfield when well grown, after a drouth and after a heavy rain, when the wash has carried the soil away in places to the depth of two, three or four inches, and you will find a complete network of fine corn-roots laid bare by the wash; not at the extreme depth of the shallow plowing, but at the very surface; and after a day or two of wet, damp weather it is not uncommon to see the ends of new roots entirely above the surface of the ground where there has been no wash; thus showing, that even in dry times as well as other times, the roots seek food and moisture near and at the surface. Every practical farmer ought to know that in dry times moisture rises from one, two, three, and even four feet deep (according to the hardness of our soil and subsoil) to the surface, before it can pass off by evaporation; all of which moisture must necessarily pass by, or in contact with these fibrous roots as it is drawn up by the heat of the sun. The poorer the soil is the harder it becomes, and the deeper the drouth will penetrate. There are certain amounts of vegetable matter and other fertilizers in all soils. The thinner the soil is, provided it contains all the elements of a deep soil, the richer it must be. Take any of our land and mix the soil of six inches deep with a poor subsoil of six inches, and you decrease the fertility of that soil nearly one-half, and so on in the same ratio in proportion to the depth; and you not only make the soil poorer, but you decrease its capacity to stand dry weather, because you increase its liability to bake or become hard, and so increase evaporation. On the other hand, the richer the soil is in vegetable matter, or the more vegetable matter it contains in proportion to its depth, the more mellow it is, and, consequently, the more evaporation is retarded and the better it will stand dry weather, all other things or circumstances being equal.

Mr. Wm. S. Carpenter.—More depends on the care of the crop after it is planted, whatever the depth of plowing may be. If the manure is put on the surface, and the ground constantly stirred, there will be good crops. For my part I am opposed to the extreme as advocated by some.

Mr. A. S. Fuller.— I do not understand how it is that men who have sense and eyes should oppose deep plowing. I do not care what any one says, there is no sense in such a thing. Corn, that can descend deep, is not affected by drouth or excessive moisture. To-day those who have trenched deep and underdrained their land, are getting rich during this wet weather. Manure comes in the rain and damp atmosphere.

Dr. J. C. V. Smith.—I was on the committee to visit Salem county, and the farms are an honor to the county and State. Whatever Mr. Pettit says is so. Perhaps the soil does not need to be plowed as deep as elsewhere. And here is an important point, which should be taken into consideration in deciding on this subject.

Mr. Solon Robinson.—I have been studying this subject for fifty years, and I do not know as much now as I thought I did when I commenced. In New Jersey it may not be necessary to plow deep. Out on my soil, in Westchester county, a man who plowed shallow would be starved to death, as he ought to be. The plowing throughout the United States does not average more than three inches. There is something in subsoil which rises and gives fertility to the surface. There are sections where deep plowing will not pay. I am not crazy on the subject of deep plowing, but I am not in favor of shallow culture.

Mr. P. T. Quinn.—Celery plants descend thirty-one inches. I have traced the roots of corn from thirty to thirty-six inches, and squashes from twelve to sixteen inches. I never knew a place where deep plowing did any harm. In market gardening, where hundreds of dollars worth of manure are used, land plowed four inches deep would not produce enough to pay for the seed. There is something wrong when the average of crops has decreased from thirty to sixteen bushels per acre.

Dr. Isaac P. Trimble.—I grant that if there is a hard-pan it must be broken; and here the difference of opinion undoubtedly arises.

Mr. A. S. Fuller.—If this club could induce the people of the United States to plow one inch deeper, it would add one hundred millions of dollars to the country.

Dr. J. C. V. Smith.—Where there is a phosphate roots will descend in search of it. On the removal of the remains of Roger Williams, at Providence, R. I., it was found that the roots of an apple tree had descended into the grave, and, wholly absorbing the bones, had assumed the human form.

Horse Flesh as Food.

Mr. Robert Ivins, Attleboro', Bucks county, Pa.—I was surprised on reading the report of the club of May 12, to see horse flesh extolled as an article of diet, particularly as it came from the president of an Association for the Prevention of Cruelty to Animals. After depicting the cruelties inflicted on cattle being sent to our markets from the west, and the inhumanity of persons whose hands they pass through, he introduces horse flesh as beef, to abate the atrocities inflicted on the ox. We presume that that valuable animal, the horse, is not abused in his passage to the eastern cities, since the gentleman says nothing about it. We would suppose that there was labor enough for the president and a large number of agents to ameliorate the sufferings of animals which cannot complain, without advocating horse meat. Mr. Bergh speaks of the use of horse flesh in France and England with the eulogy of epicures in favor of its introduction as food. Who among them would order his faithful family horse, that had served many years with all of his speed and strength, to be slaughtered and prepared for a repast? None, if truly humane. I had rather see the customs of the Chinese adopted, and have our worthless rats and puppies prepared as dainties for epicures, than the noble horse. Even if horse flesh should be considered wholesome and good, none but the wealthy could purchase it. At the present price of horses the meat could not be sold for less than fifty cents to one dollar per pound, unless they appropriate those that are useless for labor; such as have broken limbs and incurable sores and diseases, for feasting the high in life. The idea of using our horses for food, after they have labored and saved us, and helped to raise us to prosperity, would shock the sensibilities of almost every farmer in the country. The people of Bucks county would call no man an apostle who would introduce horse beef in this age.

Bread Making.

Prof. Horsford, of Cambridge, Mass., gave an interesting account account of bread making, and showing how fermentation is produced, by means of diagrams on the black-board. This was in connection with the exhibition of baking bread in a gas stove oven, from flour and ingredients which he has discovered, by which means bread is mixed and baked in a very short time.

CRONK'S STEAMER.

The committee reported that four dishes can be cooked over one hole of a stove, or on one burner of a gas stove, without imparting any flavor. For small families, it permits a large amount of cooking to be done with a small heat.

HEXAMER'S FOUR-TINED HOE.

Mr. Sinclair, Croton, N. Y., who is a good farmer, thinks that the handle should be at least six inches longer. One thing is certain, that a set of garden implements is imperfect without one. Among weeds it will do four times more work than a hoe, and much better. The simple truth is, that in a common lifetime one will throw away a year's hard work for want of it.

EVERGREEN SEEDS.

Wm. Hampton, Viola, Iowa, Marion Co.—I bought a few seeds of a traveling peddler this spring, and expect I was humbugged, for though I planted with great care, when I ought to have been planting corn, not one has sprouted. I would like Elsie Meig's post-office address; if her husband is in want of some of the best and most prolific kinds of raspberry, gooseberry, Concord grape, or seed of good kinds of rhubarb, I would take pleasure in presenting them to him, if he would remit me enough to pay postage, as I feel an interest in those settling in that new country, Kansas; or, I would do the same to others in a similar situation. This is not an advertisement, for I keep nothing of the kind to sell, and I have only a small supply for my own use, but could spare a few to those of small means. These things can be sent without difficulty through the mail, in the winter; also snow ball, or golden willow. Our county, that a few years ago was new, is now in most parts like an old county, with farms worth from twenty dollars to fifty dollars an acre; but prairie land, within twelve miles of railroad, can be had for five dollars.

Adjourned.

June 23, 1868.

Mr. NATHAN C. ELY in the Chair; Mr. JOHN W. CHAMBERS, Secretary.

DESTRUCTION OF GRAPE VINES.

F. A. Gates, Cedar county, Iowa, gave an account of planting and treatment of his vineyard. They were covered during the winter; but now, out of several hundred, scarcely one good vine remains.

Mr. N. C. Meeker.—It is impossible to tell what is the cause and remedy, since we do not know the nature of the soil. It looks as though they had been planted on wet ground and had been winter-killed. Grapes, particularly the Concord, have done remarkably well on the elevated plateau of Central Iowa, for instance, at Des Moines. This I know, for I have a vineyard out west from vines grown at that place.

Mr. Solon Robinson.—Last winter was quite trying on grapes. Even the Hartford prolific, supposed to be entirely hardy, suffered much, even in a sheltered position.

Mr. Caywood.—We lost several thousand dollars worth of vines last winter, owing to the wet summer and fall, which gave green, spongy wood, unfitted to go through the winter. If the wood is unripe in the fall the roots also will be unripe.

Mr. A. S. Fuller.—Some grapes on wet ground will have dead roots, while the tops will be green. Of course, such will die.

Mr. H. B. Smith, Westfield, Mass.—Even hardy grapes with me suffered very much last winter.

Mr. Horace Greeley.—A good deal depends on the preparation of the soil as to the ability of vines and trees to withstand the cold. I had a piece of rye on low ground which was mostly winter-killed; but this would not have been the case had the ground been underdrained. I would advise our Iowa friend to try again, and if he underdrains I venture to say he will not lose vines in ten years.

The Walter Grape.

Mr. A. J. Caywood, of Poughkeepsie, spoke of the remarkable qualities of this seedling. It was developed by Mr. Caywood after many years of patient trial, and, as they think, is destined to a wide popularity as *the* American grape, valuable alike for wine making and for the table; adapted to all latitudes, from New Orleans to Georgian bay; in each of which remote places the vine is now growing and doing well. The Walter is a cross between the Delaware and the Diana; a Delaware in size and color of fruit; a Diana in size and the growth of the vine. It does best in a thin, warm soil, and does not bear high feeding. Hence it will be the favorite vine in Jersey, Delaware, and Virginia. It is earlier than any other variety grown among us, except the Miles, a vine little known, and esteemed only for the single quality of giving the earliest fruit. The clusters of the Walter are large, and the amount of sugar quite remarkable. It is

the only grape we have that dries up into a raisin, instead of decaying on the vine.

Mr. N. C. Meeker.—How does it stand winters?

Mr. A. J. Caywood.—It never looked so well as now. The extreme cold of last season did not affect it at all. The wood is in fine order, and it seems, so far in its history, entirely free of mildew. Mr. Ferris read communications from Alexander Palmer, a well known grape culturist in Ulster county, and from others on or near the Hudson, who have this grape or have seen it growing, indorsing all the good points claimed for it. Messrs. Ferris and Caywood asked for a committee of the club to go to their vineyards; and the chairman assured him that a good committee should be sent up whenever they were disposed to make such visit agreeable.

WHETHER CROWS ARE MISCHIEVOUS.

Mr. Horace Mudge addressed a letter to the club, expressing his astonishment at the views of Mr. Fuller and others as expressed at the meeting two weeks ago. "Are you," says he, "a set of humanitarians who live in the city and have theories, but never saw a crow, or do you know what you recommend when you urge farmers to tame crows and have them all about the house and garden to pick up wire worms and caterpillars?

Mr. Horace Greeley.—I believe that crows, notwithstanding all that has been said against them, are among the farmer's best friends and benefactors. And to test this matter practically, I desire to ask if any farmer ever saw a crow eating ripe corn, or doing any kind of mischief. For my part, I do not credit the accusations that have been preferred against this useful bird.

Mr. A. J. Caywood.—I have seen crows collect in corn-fields by the thousands, and strip the grain off almost every ear outside of the stooks. I know they do an immense amount of damage to corn-fields; and I do not believe that the benefit which accrues from the grubs they destroy will balance the damage done by them.

Mr. S. Edwards Todd.—I have been so much amused at this crow discussion that I thought I would say nothing. But I know that crows are relentless robbers and blood-thirsty murderers. Every attribute in the character of these rapacious birds is as black with crime, as the plumes that cover their bodies. Like sneaking cowards, they hover about our sheep folds, and pounce upon the innocent and tender lambs the moment they spring into life, and pick out their eyes before

the harmless little creatures have sufficient strength to stand. When our ewes are passing the yearning season, we must stand over them with a cudgel to protect young lambs from these ravenous marauders. I well recollect when a boy, of rescuing a little lamb from the talons of a crow, after he had picked out one eye; and I saw the animal after he had grown to be a large sheep with one eye. During the period when crows are rearing their young ones, they will dive down among our fowls and carry off chickens, turkeys, ducks, and goslings to their broods. I have known them to dart down within twenty feet of my dwelling and swoop up chickens and turkeys as large as quails, and larger. And their rapacity does not end here. They sail around the fields and rob every little chippie's and robin's nest of the eggs, or the young birds, in the most relentless manner, even when the trees are covered with worms and the ground filled with grubs. The "carrion old crow" has not one single redeemable virtue to entitle him to an existence among the feathered songsters of the grove. The Creator has fixed the same mark on this cowardly scapegrace as he fixed on old Cain, as the sign of a murderer, and that all who meet him may slay him.

Mr. A. J. Caywood.—It will be hard to prove the ideas of farmers on this subject to have been all wrong for a thousand years. For instance, I know the robins eat my cherries, and that I can protect my fruit only by killing some of the robins so the tribe will take warning.

Mr. Horace Greeley.—For my part, I would rather the robins would take all my cherries than to load a gun to shoot one of them.

Traverse Bay, Michigan.

Albert Allen, Traverse City.—We have a good country here, free from ague and bilious diseases. People have to work here to provide for their families, and make for them comfortable homes. It is no place for idlers, nor persons who are easily discouraged; but if you want to work hard, and eat hearty, come along and bring your wife and little ones. The country is rapidly settling up, but there will be a good chance for poor folks for years to come. If you are a mechanic or a tradesman, and want to settle in town, rent or material for building will be cheap; your fuel will only cost the hauling, and your entire cost of living, including everything you have to buy, will be about ten per cent less than in Ohio, and fifty per cent less than in Eastern New York and New England.

Fruit growing is attracting much attention, and thus far has been entirely successful. Peaches and grapes are especially productive.

There is an ample school fund, and schools are encouraged. I say to every man that has a family, be your own masters, your own lords of creation. You can be, you ought to be; you owe it to yourselves, and, above all, to your families. I do not advise you to come here. Choose for yourselves; but go to some new country, and if you are worth the postage which it takes to carry you thither, you will probably become the father of a respectable family, and the owner of a pleasant home. If any are desirous of learning more of this country, send stamp and we will cheerfully answer. If any are not able to send stamps, we will answer their letters just as cheerfully, as we have been enabled to make something more than a living in this new country, and can spare a few stamps without inconvenience.

GOOD SEED.

Mr. L. Herrick, Oberlin, Ohio.—It is stated that corn in New England has given an increased yield on account of the care taken in selecting the most perfect seed; also large yields of wheat are secured by selecting the best kernels. This I believe is the true principle, whatever is to be reproduced, whether animal or vegetable. In planting potatoes, my practice has been to select for seed, in part at least, such sizes as I wished to produce, and take my seed only from the product of these. If small potatoes are planted never take seed from them. By continuing this practice a series of years I am fully satisfied that my crops are considerably improved in yield and quality. There is no crop the farmer produces where there has been such a disregard of the true principles in the selection of seed as in this; and no crop has deteriorated into such unsatisfactory results. The fact that a good or even superior crop is sometimes produced from inferior seed is not sufficient to set aside this obviously correct principle. No farmer thinks of selecting little nubbins of corn for seed; and, if compelled to do so for a season, could not believe it best, though a good crop might result.

DEEP PLOWING.

Mr. C. E. Snow, Hanover, Jackson county, Michigan, speaks of the proneness of mankind to theorize, and he thinks the Farmers' Club recommends methods at times without sufficient foundation. Among these is deep plowing. If the advocates should come out to

Michigan and attempt to put their theories in practice, they would have to cave in. "The most successful grain raisers whom I know do not on an average plow deeper than from six to eight inches. The rootlets of the plants require the influence of the sun's rays, and the roots of wheat and corn do not descend perpendicularly more than three or four inches. Those roots are the largest which run laterally and nearest the surface. This is demonstrated by the largest roots of a tree running laterally. The top root is a prolongation of the trunk. Each root diminishes in size in exact proportion as it leaves the surface. Finally, the soil is most porous in its natural condition, which is proved from the fact that the dirt we shovel out of a hole will not again fill it. These facts and experience teach me that eight inches, with surface well enriched, is sufficient for all kinds of grain."

Blue Grass and Clover Seed.

Mr. J. H. McKinsey, Secretary Stamford Farmers' Club, Lincoln county, Ky., sent specimens of the above, which were handed around among the members and much admired. That of the blue grass was cut June 10, and was over four and a half feet high. The seed of the cane, such as fish poles are made of, Solon Robinson called a curiosity, as it has been thirty-five years since the cane blossomed. The blue grass, the writer said, is allowed to grow from twelve to eighteen inches high before it is grazed. Crop prospects in Kentucky are flattering, though fruit will be light. There is a great want of manufacturing establishments of all kinds, and in particular of agricultural implements. Mechanics even with limited means can do well. Lands are of every grade, from one dollar to $100 an acre. Clover seed comes from the second crop, which should be allowed to get dead ripe; it should be stacked the day after cutting, and in the same way as hay; it must not be dried too much, or a considerable seed will be lost in handling. Cover the stack with at least eighteen inches of straw or timothy hay. If no clover huller is to be had, it may be tramped out in dry frozen weather. A good average yield is two bushels of clover seed to the acre.

Mr. J. E. Snodgrass.—Having recently been through a part of Virginia, I saw that the time has come to introduce machinery there.

Barberry Hedge.

Mr. P. Allyn, Benton Harbor, Michigan.—I want to say a few words about the barberry. One fact is worth half a dozen guesses,

and I have experimented on barberry for ten years, and cannot see its character as some do. Ten years ago, or about that time, I planted 100 barberry bushes in Delaware county, Iowa. The following winter, on thirty different days, the mercury sunk down from ten degrees to thirty-eight degrees below zero, and it did not injure the barberry. This ought to establish its hardiness. Four years ago I planted ten rods of small barberry plants for a hedge on my place. That hedge now appears much like a perfect fence. Man or beast would try more than once before passing through it. Two years more of such growth as it had last year would make it hog-tight, horse-high and bull-strong. As to its blasting crops, I have raised wheat, corn, sugar cane, potatoes and many varieties of fruit right along beside the barberries, and the only thing I knew blasted was a few *blasted* English gooseberries, which always blasted, even when far away from the barberries. A Massachusetts man complains of the seedlings springing up. I will pay him $100 for 20,000 such plants delivered to me next fall. One writer complains of their sprouting from the root, and becoming a nuisance. I deny that one plant of the barberry ever sprouted from the root. It does, it is true, throw up each year straight sprouts from the collar of the plant. The second year said shoots throw off lateral branches, which lock the interlock with the previous growth. All of these sprouts unite below the collar in one central root, which at the depth of eight or nine inches branches out into proper roots, but I have never seen one bud on the root of any plant of the barberry. Let no one send to me for seeds or plants for I have neither for sale. I do though fully believe that the barberry is yet destined to become the great hedge-plant of America.

June 30, 1868.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

CHEAP BUILDINGS.

Mr. R. G. McDougal explained at some length a method, called by him building by steam. Its chief idea is this: To produce at lumber yards and in shops furnished with steam-driven machinery, all the parts of a house or other building so fitted that it can be put up in a day by three or four men. He says there is no more difficulty in erecting a house than in setting up a bedstead, and that the carpenter and joiner work can be done far cheaper and quicker by machinery at the

shop or yard than by hand on the spot. He can put up a cottage house by this plan for $2,000, that by the common plan would cost $3,000. "The whole system of building," says Mr. McDougal, "can be superintended and looked after by one or two men, and more general satisfaction given, and the whole work done more promptly than by having a dozen different bosses or contractors, and then have one waiting for the other. As for the smaller classes of cottages or villas of from two to eight or ten rooms in frame buildings, one or two stories high, I have succeeded, after devoting much time and attention, in arranging the system so that the entire work can be put together at the shop and ready for erecting on the ground as fast as it can be hauled there, and a gang of five men can set up a cottage of from six to eight rooms in a day, and it will be ready for the inside finish or plasterers to proceed the next day, and when completed they are better buildings than the common timbered frame houses, and can be made just as plain or ornamental as the parties may desire to have them. I make bold to say that there is not a frame building in this city or surroundings that will surpass them for strength and durability. This same system will apply to school houses, churches, hot-houses and many other classes of private as well as public buildings. This is a fine field for investigation or investment. These buildings are wanted all over the country, from Maine to Mexico, and from the Atlantic to the Pacific, but nowhere more than here.

The Romeyn Seedling.

The committee sent by the Farmers' Club of the American Institute, consisting of Messrs. J. B. Lyman, Dr. J. E. Snodgrass and A. B. Crandell, to investigate the qualities of the seedling strawberry developed by Mr. William Romeyn, of Kingston, in Ulster county, submit the following report: We visited Kingston on yesterday, the 29th of June, and saw a great number of the plants growing in the garden of Mr. Romeyn and on the grounds of several of his neighbors. The committee were at once impressed with the size and thrifty condition of the plants and the large number of berries, ripe and unripe, with which they are loaded. These vines are runners planted last September. They are of such size that Mr. Romeyn finds it best to set them three feet apart each way. We observed several which measured two and a half feet across. A large number of these plants had two dozen large ripe berries upon them. From one we picked thirty-five strawberries as large or larger than the usual sized

walnut. On another we counted fifty ripe berries. These plants are growing in the soil of a sterile sandy plain that had been fertilized moderately and spaded to the depth of ten inches. In another garden we saw Wilsons that will not yield another picking, and were set out at the same time with the Romeyn, last fall, while the matter will yield first-class berries for ten days or two weeks to come. In the gardens of Mr. Valentine Bergevin, a very successful cultivator of flowers and small fruits, we saw the Romeyn set side by side with a dozen approved varieties. It yields as well as the Wilson, the Agriculturist, or Russell's Prolific, and in flavor and appearance resembles the Triomphe. Mr. Bergevin, who cultivates largely for market, selling over two hundred bushels this season, says he shall plant no more Triomphe, because the Romeyn sells as well and bears much more generously and with certainty. His soil is a cool, heavy clay, on a western exposure. This he under drains with cobbles; spades eighteen inches deep, and fertilizes liberally. On the farm of Mr. Joseph Foster we saw the Romeyn on a rough, slaty soil, shallow and but little fertilized. But his plants are vigorous and productive—likely to give him a quart in all pickings to each plant. His last picking may be as late as the eighth or tenth of July. We selected twelve berries from Mr. Romeyn's vines and found the aggregate weight twelve ounces. The best plant in his garden is six years old. The conclusion of your committee may be summed up as follows:

1. We find the Romeyn a remarkably vigorous plant and a large bearer.

2. In color and size it is equal to any berry that has any merit for flavor.

3. In its origin this berry is supposed to be a cross between the Wilson and the Triomphe, the leaf and runners resembling those of the Austin.

4. As to flavor we think it will equal any large berry now presented in market.

5. There is good evidence that, unlike the Wilson and most other kinds, it would not require frequent resetting. Plants six years old are abundantly fruited.

6. To-day, the last of June, the Romeyn is in its flush. Its season

will continue a week or ten days longer, thus giving to our market a first class berry ten days later than the older varieties.

All of which is respectfully submitted.

J. B. LYMAN,
J. E. SNODGRASS,
A. B. CRANDELL,
Committee.

This report was accepted and Mr. Carpenter indorsed it by a special statement in favor of the Romeyn. He has it in his gardens, and finds it a strong, thrifty, and valuable species.

Early Rose Potatoes.

Mr. Wm. S. Carpenter showed potatoes larger than hens' eggs, thirty-nine days from planting. The Club were unanimous that no other early potato shows such vigor and thrift.

Important to Dairymen.

Mr. M. F. Potter of Kanesville, Illinois, showed the Club a combination for cooling milk as soon as it leaves the udder, to the temperature of forty or fifty degrees. The results in superior cheese, first-class butter, and delightful milk from subjecting milk to this process are surprising and challenge attention from all the milk producers and consumers of the country, and this includes the whole population. The Chair appointed a committee consisting of Messrs. J. B. Lyman, W. S. Carpenter, and Mr. Whitney, to go to some dairy farm and experiment with the apparatus of Mr. Potter, patented by Watson Peck, and report to the Club the result of their trial.

The regular hour for the paper of the day having arrived, Dr. J. V. C. Smith took the stand, and read the following, on

The Natural History of the Cow.

Domestic comfort is associated with the idea of a cow. How largely milk contributes to good living—light bread, excellent butter, custards, cakes, puddings, and rich cream for coffee cannot be had without milk of the first quality, which is now a desideratum in Boston, New York, Philadelphia, and many other cities. They pay large sums for Cochituate, Croton, and Fairmount water delivered daily from milk carts, besides that which is received through lead pipes into their apartments. No one in his senses would presume to question the dietetic virtues of milk. It is the food provided for the newly-born animal, from

which is elaborated materials for the completion and development of its organic machinery. There is no other product from any source in nature so extraordinary in composition. Huge frameworks of bones, muscles, and nerves are fabricated by vitalized tissues from elements held in solution in that wonderful fluid, which is directly secreted from the circulating blood. Innumerable tubes, valves, ganglions, a spinal column and a brain which controls the whole, are nourished and increased in volume from simple milk. Truly, therefore, its chemical ingredients, the manner of its origin, and the purposes it subserves in the economy of nature, constitute a distinct department of study not beneath the consideration of the most gifted intellect. Still, thousands upon thousands familiar with these general facts vitiate their digestive powers and ruin their health with destructive drinks that afford neither nourishment nor satisfactory results of any kind. Milk never inflames the mucous membrane of the stomach or bewilders the intellect. It meets the demands of our physical organization, conducing to serenity of mind, a happy state of the body, and promotes long life. Whenever it disagrees with an individual, the cause is referable to some abnormal condition of the system, and not to milk, if drawn from a healthy source. Modern refinements of the table make disastrous inroads upon human life. Highly-seasoned dishes cannot be habitually indulged in without detriment to the functions of the digestive apparatus. Our ancestors had simple food. Their flour was not so finely bolted as our own, nor did they purchase either diluted or artificial milk. Of course they lived longer, were exempt from maladies now common as the inseparable misfortunes of advancing civilization. In cities, where the strife for position keeps the population in active commotion, and phantoms of the imagination are too often supposed the substantial foundations of happiness, and where, to the disgrace of christian communities, respectability is measured by rents and dividends, the felicities connected with keeping a cow cannot be appreciated. Many reared in dainty affluence, associate plebeianism, vulgarity, and small means with that form of country comfort which includes a cow. But it is a mistake that should be corrected by education. Cows are exceedingly interesting animals. When well trained and regular habits are established, a philosopher may find something in their character for profound study.

Give the range of a pleasant pasture, studded with shade trees, a shed to retreat to in the yard, and a comfortable stall for winter

quarters, and the cow becomes a model of quiet docility, orderly, with an expression of contentment. She is no contemptible sight. There is a solemn independence of gait, when the bag is full, refreshing to contemplate. Her walk is slow, as it should be, otherwise it would interfere with the lactic secretion. Their locomotion should never be hurried unnecessarily, since their gastric capacity is altogether too large to urge them rapidly, especially when the paunch is distended with succulent food. A cow has memory. "The ox knoweth his stall and the ass his master's crib." But being social in disposition, two cows do better than one alone. They actually love company. That is a trait in the character of all grass eating animals. If they have had a companion for a while, and then it is taken away, the restless uneasiness manifested is apparent. Farmers understand the value of that kind of influence, since several oxen, cows, pigs or sheep thrive and fatten faster together than one would alone. They are disposed to huddle together, especially towards nightfall, which, in a wild state, as in buffalo herds, gives a sense of greater security. Cows evidently delight to repose near each other by the road-side or in closed yards, after feeding through the entire day. Chewing the cud is a social occupation for cows, hours in succession, as they rarely rise upon their feet till the following morning. Rumination is a function that has very much perplexed physiologists. All the ruminants have four stomachs. Sheep, oxen, goats, camels, deer, rabbits, gazelles, etc., are alike in that respect, requiring periods of rest in order to rechew the contents of the rumen or paunch, which is simply a receiving sack, contributing but little towards altering the appearance of whatever may have been swallowed. Before the food is prepared for entering into organic relations with the animal, it passes from one mill to another, till that which was green grass at first is converted into a delicate white curd. On leaving the first stomach (*abomosis*), it passes into the intestine, where it is urged onwardly by contractions of the tube through an extent of forty-six feet in sheep, and very nearly the same length in all the herbivori. Sliding by the open mouths of multitudes of lacteal vessels or milk-suckers, mixing on the way with various glandular secretions, it is finally poured into a vein to circulate with and to become blood. In that manner food is vitalized. How literally true, therefore, the declaration of the Psalmist, "all flesh is grass," instead of being a poetical fiction. Analyze the phenomena of converting grass into beef. A very large proportion of land is covered with vegetable growths,

which derive their sustenance from the atmosphere and inorganic materials in the soil. The cattle upon the thousand hills are all busily employed in transmuting vegetable matter into a new material that alone can supply the alimentary necessities of carnivorous animals and omniverous man. We cannot live on grass, nor can lions, tigers, cats, wolves or dogs. They are constituted for feeding on animalized food. It must be nearly like their own flesh, so that when swallowed, it is quickly appropriated for repairing the ordinary waste going on in their own structure. The difference between machines of our invention and those vitalized, animated organisms is this: The first wear out without repairing themselves. Nature repairs itself, and there produces an exact fac-simile of its own internal and external form, leaving a new machine to succeed that which ultimately becomes worthless. Thus sheep, cattle, etc., begin the process of preparing suitable nutriment for us. Being unpatented machines for transforming vegetables into flesh. When that act has been accomplished, then we actually eat the machine. This, therefore, comprises the whole history of the life of a cow. Philosophically viewed, the subject requires further elucidation. The tongue partially rotates with a finger-like movement, that winds hay or other fibrous food into a more compact form. Lubricated by saliva in the mouth, it rolls down the long throat canal to the paunch, analogous to the crop in birds. Another follows, till a sense of satiety is when the hopper is full. After remaining a few hours, a mass of loosely packed grass balls, the animal being at rest, one of them instantly ascends the gullet which reconducts it to the grinders. Subjected to thorough mastication, being softened for the operation while lying in the paunch, and reduced into smaller compass, it is swallowed again. Thus each cud traverses the gullet from one extremity to the other, over a surface of about one yard each way, an aggregate of nine feet. In dropping it into the bag the second time, an opening into a second stomach allows it to slide in and then closes the communication till the next cud arrives. Nothing is permitted to pass through the gate that does not give an appropriate countersign. If indigestible articles were to have ingress immense constitutional derangements would ensue, destructive to life. Balls of hair are quite common in the rumen from one to four inches in diameter, which cannot get through the portal. They no sooner approach it—impelled in that direction by a contractile force of muscular fibres in paunch tissue—than the sphincter hugs tighter to keep it

out. When the cuds have undergone further chemical alterations in the second stomach, a further door opens its portals and the stranger passes into a third receptacle, when the green color is lost for a creamy hue and consistence. Lastly, in the fourth, the renet or abomosis, the rich, thick chyle is coagulated by contact with an acid fluid, when it is ready for use. Next day, having been ærated in the lungs, it commingles with arterial blood and becomes beef. It is a chemico-vital process, which science explains but cannot imitate. Milk is secreted from the circulating blood and not directly from the food supplied the animal, and conducted to the lactic receptacles in the bag.

There is a wide difference between social freedom and social restraint, even among dumb beasts. In open air, cows have fine health. If several are confined together in badly ventilated stables, disease develops. Large numbers in small areas, where the product of the land is disproportioned to its occupants, engenders sickness. When one or two hundred are confined to stalls, however theoretically perfect the ventilation, individual organs become ulcerated, and abscesses are found in the liver and lobes of the lungs.

Large bodies of cattle ought never to be placed in small lots for feeding, because the accumulating offal, enriching as it may be to the land, injures the quality of grass by besmearing it so that it is offensive to them. Tufts or hillocks bearing a flourishing growth in such localities are numerous, but invariably avoided by hungry animals. By alternating, placing them a while in another inclosure till rains, dews and atmospheric influences have washed and cleansed the spears and blades, important advantages accrue. Examinations of mammoth dairies in London, especially one, where 400 cows were stalled some hygiene facts were gathered of practical value to farmers. Although they were large, sleek, noble looking animals, they did not yield as much milk as the size of their udders seemed to indicate. They were fast to a perpendicular stanchion by a sliding ring, which merely gave the poor prisoner a choice of standing or lying down. Having no other exercise or change of position, if any of them escaped organic derangement, it would have been more extraordinary than that they should have sickened. Eating, drinking, sleeping, and secreting milk was their prescribed service. But milk produced under perpetual duress, could not be as wholesome and nutritious as under circumstances of pasture freedom. On an average, said the proprietor, there was a dead cow every morning. They were milked up to within a few hours of death by ulcerations

and abscesses in the lungs, liver, or organic leisons of the heart, What kind of dietetic properties could such milk possess when diluted with London water! Bills of mortality chronicle the sequel.

To keep pace with that diurnal loss, agents were always ranging the country for others to supply the vacated stalls. They collected at a farm not far from town, from whence they were driven according to circumstances, to the city. The kindly disposed owner of the establishment informed further, that the cows rarely gave any indications of being indisposed, so that each death was a surprise. There are other dairies in London managed on the same general plan, probably with very similar results. Mr. Ross Wynans has a famous city dairy in Baltimore, which has received commendation from practical farmers, who, it is apprehended, had their judgment swayed by the apparent success and economy of arrangements. Visitors whose thoughts are perpetually exercised upon the subject of bettering poor lands, manifest extreme delight with Mr. Wynans ingenious contrivances for feeding, watering, milking ricking cows and saving manure. The shelter is admirable, and so is the register suspended by the side of the stall for showing the day the occupant was received, her cost, daily yield of milk, &c. But the poor creatures, though fat and quiet are nevertheless prisoners. Could they relate their views, they would be unanimous for emancipation, and green fields.

Mr. Wynans is immensely in advance of the London dairymen, and it would be to his discredit were he not, with prodigious wealth and extraordinary mechanical ingenuity. Report has it that his cows thrive by his management, gain flesh and bring extra prices for having graduated at the Baltimore Cow College. I apprehend his sagacity enables him to put them into market before organic diseases begin to develop.

In the south of France, Belgium, and throughout extensive regions of Asia and some parts of northern Africa, cows are worked in the yoke to plow, draw in carts, and in a word, are laboriously tasked like oxen and bulls. In conversation with a Belgian farmer on the impropriety of putting them to such service, on the score of spoiling the milk, he would not admit it was of any importance, closing his remarks by expressing an opinion that cows should work for a living as well as oxen. They milk them all the while twice a day. Surely the quality of the milk must be inferior, having less casein or butter globules, and therefore less suitable for food. It would be largely made up of serum or whey, proportioned to the hardship imposed

upon the cow, and the interruption in the way of perfect digestion, and lacteal secretion. In this country and England, the nutritious properties of milk are not conceived to be any too good when the cow leads a life of gentle repose.

I have seen them in Syria yoked at the extremity of a pole nearly ten feet long, with a donkey, camel, or mule, indifferently, at the other. Of course they are deteriorated representatives of a noble race, with small scraggly horns, small udders, and miserably small milkers. Sheep are milked extensively in some sections of Asia Minor, like goats, giving quite a large yield, but the milk is not agreeable to my taste, at least. The bags become almost equal to that of cows in size, which have to be protected by a coarse piece of sail cloth, held up by cords over their backs, to prevent lacerations and contusions, in ranging among ragged hill-sides. Wise and familiar as every one presumes himself to be who keeps a cow, there is still room for improvements in the manner of feeding them, with a view to increasing both quality and quantity of their milk.

It is assumed, *a priori* in this communication, a mistake that cows may be fed with anything. Oil cake and similar compositions conduce to a kind of apparent fattening, which is rather a bloating of the fat cells than real fat. Garbage from a kitchen is no better than slops from a brewery or still house. They may be coerced, as it were, into eating such products, but it's unnatural food. Liquidity is not a quality to be sought in their diet, nor should it ever be warmed. Mr. Wynans softens hay in a hot bath, rolls it to flatten the tubes into a soft, mushy mass, on the theory it facilitates digestion, saves time in chewing, and more milk follows. He is mistaken on every point, if naturalists have truly interpreted nature. It would be wearisome to a popular audience were I to attempt a physiological demonstration of the *modus operandi* of the function of digestion in ruminants. Four stomachs were placed in their bodies for a definite purpose. There is neither economy, humanity, or morality in cooking food for animals designed in the constitution of things for chewing the cud. Were careful investigations instituted, it is probable that it would be found that milk made from miscellaneous food is of very little value; and further, it is positively injurious in the human stomach, introducing elements wholly unsuitable, and the origin of cutaneous eruptions, nausea, diarrhœas, and perhaps graver maladies. The fresher and more cleanly the cow's aliment, the richer will be her milk in those ingredients which give it universal reputation

among all nations as appropriate human food. Grass, fresh or dried, is her natural pabulum. Cereals furnish starch, but the coarse coverings of grass seeds and grain carry products into their systems indispensable to the perfection of their natures. Concentrated feed is not suitable for them. Their internal organisms are the best mills for them, since the stimulus of distension is essential in their organic economy. A full abdomen is a sign of perfect health, made so by their ordinary habits of life.

Indian meal, peas, and especially crushed beans, of which they become exceedingly fond, contain a large percentage of casein, are each and all of them excellent, fed out with discretion. Alternatives in diet, in a state of domestication, however, it should be remembered, is of the first importance in maintaining their health. Succulent roots abounding in sugar, such as beets, carrots, etc., are generally relished. Potatoes furnish starch, which is converted into glucase, a sugar paste, after it leaves one of the stomachs. Turnips, squashes, pumpkins aud fresh cornstalks, which furnish a large quantity of sweet juice, when fresh are admirable. All of them should be freed from grit. Their teeth are injured by whatever carries impurities of that sort adhering to it. Warm slops produce caries if persisted in for a season or two. Scrofulous sores sometimes are produced in that manner, it is supposed, and scabby patches, denuded of hair. All juicy garden plants are eagerly sought by milch cows, which furnish saccharine matter. Those which they reject must be useless. Feed them occasionally with sugar.

When the perpendicular septa of bone between the plates of enamel are injured by warm semi-fluid food, cows experience pain, indicated by extending the neck, shaking the head and leaving the vessel from which they are feeding, with its contents, although craving nourishment at the moment. Cows are used for burden in common with bulls in many semi-barbarous countries. A farmer by the name of Thatcher rode a cow to market of Stockport, in England, during the American revolution, to bring contempt upon Mr. Pitt's unpopular tax on horses for carrying on the controversy. Barbarous operations called spaying, are occasionally performed on them. It prevents them from having calves, with an idea of keeping them perpetually in milk. They can be brought to milk without having a calf, but it is an unnatural process, not to be encouraged.

Maiming cows is a custom only practiced in Christian countries, and belongs to that catalogue of cruelties we practice, but which nei-

ther barbarians, pagans, or Mahomedans ever were guilty of doing. Maiming horses and bulls, too, destroys the grandest traits of their character. Emasculation arrests the development of the brain in them precisely as it does in eunuchs. But, with this difference, they do not lose all their characteristic nervous force, which may be urged to some intensity by coercion and fear. The horns grow larger and longer, and they may be more readily fattened, but it is at the expense of their muscular strength and intelligence. Horses, uninjured in that respect, are susceptible of higher training; they have more sagacity and a nobler bearing. Squirrels are the only animals which abuse each other as Christians abuse the best servants they have, the horse and bull, and that is in conformity to a law that insures the best stock for a progeny.

Those nimble creatures skip from limb to limb with such adroitness that, eluding the strongest and best developed which are designed in the fitness of things for progenitors, the weak and feeble males are prevented by a singular instinct from becoming parents. But those animals which move about on the ground, fight for possession, and thus no deterioration in blood is permitted.

Our domestic animals are governed by a sense of fear, and not affection. They are, to a limited extent, susceptible of moral sentiments, left as they were designed to be, unmutilated. Circus horses and blood horses can be taught what geldings cannot be taught, because an arrest of brain development destroys the ability for high instruction, but makes them timid and vigilant through fear. The Arabs never strike their magnificent stallions a blow, yet their docility surprises strangers. Little children may play between their legs while they put their arching necks, in proud bearing, quite into the family group to be caressed. A single bull harnessed in a cart made without a nail or a scrap of metal, draws eight hundred weight of furs and a half breed Indian from the Hudson's Bay settlement to St. Paul, Minnesota, annually, and back—all of 900 miles. An ox could not perform the labor. They are tractable, docile, and managed with as much ease as a kitten. Bulls have vigor, courage, intelligence, and twice the strength of oxen.

An arrest of development marks the eunuch. The brain remains small, the voice never changes, the beard never appears. I have seen them of all colors, and been in countries where they are maimed for the markets of Turkey, Persia, and Egypt, bringing prices proportionate to their capacity, which is always of a low order. Cows form

singular attachments for animals wholly differing from themselves in structure and habits. When a young lamb is placed in their company some one of them generally gives more attention to the little stranger than others. The lamb soon appreciates it, and attaches itself to the foster mother, regardless of all others in the herd.

It walks, feeds and sleeps by her side. When the pet strays away, the cow manifests concern, and expresses satisfaction when her favorite returns. A trait in the character of the sheep thus reared, under the familiar name of cosset, is equally anomalous. Under no system of persuasive discipline can the lamb become reconciled to its own kindred. If placed with a fold, on the first opportunity it will escape and seek companionship with cattle if the old friend cannot be found.

There is another still more extraordinary attachment cows are represented to form, revolting to our sense of fit companionship, as most quadrupeds exhibit an instinctive hostility to reptiles. It has been repeatedly related that cows have been detected in nursing serpents, going aside at obscure points as though there were a wrong being perpetrated, and looking for the unnatural associate to come and nurse.

I cannot credit fully these assertions. They are said to be most common in border regions, where cattle graze near extensive marshes, the home of the black snake, the kind accused of this practice. Discovery was prompted by an effort to ascertain how the cow had lost all her milk, days in succession, when it was apparent no theft had been committed by men, for there were no inhabitants in the vicinity; cows occasionally nurse themselves from a morbid appetite for fluids.

Serpents are all carnivorous; slaying the animals, they swallow them whole; but they require water, and it is possible, by a nice sense of smell and a keen instinct, they go to the fountain of milk; exercising a magnetic power called fascination, over the cow, till they have actually drained the bag. My experience furnishes me with no facts in the case, and yet it is difficult to disprove the declarations of apparently very honest people who testify to what they have seen and declare to be absolutely true. A gentleman of New York from Kentucky, assures it a positive fact that the black snake performs that singular feat.

Another resident of this city, who was reared in the country, assures me that there is no doubt in regard to the impression among farmers, that the black snake, the boa-constrictor of this continent, does all it is accused of doing. He says they select a cow, perhaps grazing remotely from others, approaching her so as to get her fixed

attention. She seems bereft of the power of locomotion. Gradually approaching, the monster glides slowly to the udder. The suction appears to be equally paralyzing, for she remains entirely quiescent. After that she seeks the interview, and is uneasy till the operation is finished, when she returns to feeding. In keeping one cow it is important that she should be contented, otherwise, the product desired will not equal expectation in a return of milk. Comfort is everything about a cow's home. When educated by kind care, she exhibits a spirit of satisfaction immensely influencing the milk secretion. Their maternal proclivities should be indulged as often as once in three years at farthest. Even cattle want something to love and caress. Their fondness for the calf, and the boldness with which they protect it against threatening dangers are familiar exhibitions. Milking tubes thrust up the milk ducts, or hydraulic apparatus may be expeditious methods of milking, which may beguile a purchaser into the belief that he has a labor-saving, economical appliance; but the human hand is the best machine ever put in motion for milking cows and least liable to produce injurious consequences.

Without daring to plunge into a sea of technicalities, the language of science in its highest forms, the foregoing observations were designed to be plain expressions, with a view to encouraging those who are not entirely familiar with the natural history of the cow, to watch her movements and study her habits. It will afford interest, and it may largely contribute to the advancement of that kind of practical knowledge which may turn to profitable account, while it will make us more considerate and kind in our treatment of a very useful animal, especially adapted to our use.

The horse, the ox, cow, and sheep are pillars which sustain the burden of mankind. They are his servants, clothing us with their wool, providing coverings for our feet; working in yokes or harness, and carrying us on their backs. What would civilization do without them? Savages and barbarians could not dispense with them. They have accompanied man in every age and in every country, and they should have that care and protection which evidences our appreciation of their indispensable importance in the economy of life. The merciful man will be merciful to his beast.

The address of Dr. Smith was received with frequent marks of approval.

Mr. A. S. Fuller, inquired why so many horses are diseased. A sound animal is a rarity.

Mr. Wm. S. Carpenter.—One great cause is their being put to work so soon. Horses are not developed until five, six, or even seven years old, and they should not do much work till they reach this period.

Mr. Solon Robinson.—No subject could more profitably engage the attention of this club than the consideration of the best breeds. Cows do better when they have the company of their kind, but it is the fashion to have such large animals that often only one can be kept. For my part, I am in favor of the little Alderney. Still Mr. Allen, the author of a recent work on cattle, is opposed to them, because they will not make much beef. The subject of supplying dairy products to families is of more importance than furnishing meat to cities, and I would like to have the matter taken up, that people may know which is the best kind.

Dr. Isaac P. Trimble.—I agree with Dr. Smith regarding warm and manufactured food for cows. I know it is prepared by some who invest a great deal of capital and labor in trying to do something particularly nice, but I do not believe it pays or is good for the animals. I once had a cow which it seemed to me was the best ever in this country. She had a slight dash of the Durham, but was mainly of the common scrub stock, and quite ungainly-looking. She gave thirty-six quarts of milk a day. So remarkable was this, that I paid great attention to her, and I discovered that she digested her food in half the time other cattle do.

STRAWBERRY SHOW.

Mr. Hexamer, of the firm of Reisig & Hexamer, showed a great variety of strawberries from their grounds at Newcastle, Westchester Co., N. Y. Great efforts have been made to secure a strawberry which will include all the good qualities of many but this will be impossible, because, should this be done, there could be no improvement afterward. After many trials, and through a wide extent of our country, the Wilson is found the best for market. It is hard, of good size, keeps longest, and will sell after being picked three days, though it must be picked in good order. In the long run none pays better, whether with good or poor cultivation. Of 100 boxes in our market, ninety-nine will be the Wilson. The Triomph de Grand is the handsomest fruit, though its coxcomb shape is unfavorable. To some, however, its odor and flavor are insupportable. As a general thing it brings double the price of the Wilson. It requires

a hard, clay soil, and does better in a wet than in a dry season. It is valuable as a late variety. We aim to raise late fruit, for we find that it is equally valuable with the early. In December we mulch with rye straw an inch deep, and let it lie in the spring as long as possible, nor do we wholly remove it from the ground. Jucunda, or Knox's 700, is similar to the Triomph, but not quite so scarlet nor of so fine a flavor. The Agriculturist does not do as well as formerly, and I am afraid it will die out. Barnes' seedling is productive, sells at a high price, and is coming into favor. Of 100 varieties on our ground, the Brooklyn scarlet (one of the *Tribune* strawberries) is the earliest, is of fine flavor, but too soft for market. Burr's pine is valuable for garden culture, and desirable for family use. Green Prolific is late, but is soft and poor. Rippawam is large, but not productive.

Mr. Pennell of Norwalk, Conn., exhibited some seedlings of a large size and fine flavor. Ferris and Caywood, Poughkeepsie, send seedlings quite promising.

Adjourned.

July 7, 1868.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Florida.

J. A. McDonald, of Mellenville, Orange county, Florida, gives the following account of that State: I read every sentence of your reports with profound interest. It caused me to come to Florida, and I am grateful for it. It rescued me from the jaws of death, saved me from the monster consumption, and restored me to health and vigor; but it is saddening to know that such an insignificant refugee will not be missed from the host yearly devoured by that dreadful scourge of the *frozen regions.* It grieves me to see, from time to time, such erroneous statements concerning this country, by some of our most reliable men, who are mistaken only because they don't stay and examine as they ought to before giving their opinions, when the future welfare of so many of our countrymen depends on them. I have worked at making timber, clearing hammock land, and every sort of trying manual labor more than a year, and instead of my energies failing they are decidedly improving. Let me cite one instance to show that men retain their vigor in this country, all statements to the contrary notwithstanding. Mr. John Hughey was born in Georgia, in the year 1792, of parents who were natives of the

same State, he worked at timbering till he was forty-two years of age, lost his fortune and his health, came to Florida almost penniless, worked hard, and before the war was worth $20,000; the war "broke him up;" he is now seventy-five years of age, the father of twenty-two children, fought in the war of 1812, and is at present strong and in full mental and bodily vigor, building a saw mill by the day at millwright's wages, and works twelve hours a day, and walked twenty miles to vote at the last election.

There are men born and raised in this country, who can split three hundred pitch pine rails in a day, to my own knowledge, and can assure any one that there is a larger per cent of lazy men in the north than here. Any man who has been lazy north will be lazy here. There is no cold to prepare against, and if you don't plant in spring, you can put it off till summer, fall, or winter, and all these tend to make one indolent. I have traveled through the whole country, and after mature deliberation have arrived at the conclusion that the white man, *instead* of the *black*, was intended to work. No one who knows their habits in their native Africa, will dispute it; and since the surrender they are falling back to their natural condition in this climate, where they can live chiefly on the natural products of the soil. The native white population of South Florida will stand a comparison with any community in the north whose pecuniary circumstances are similar, and a more hospitable and kind-hearted people are not to be found on the continent; they nearly all voted against secession and were coerced into the struggle. Robberies are unknown, and a man from the north, no matter what his political opinions are, is safer here than at home. I could find enough to say in praise of the truly delightful land to fire you more than this unpretending effort, but will be glad to impart all the information required by those men who make inquiries about the new countries, if they address me by mail, stating all the questions they wish answered.

WATER IN KANSAS.

Mr. M. S. Hall, of Worcester, asks about the water of Kansas, whether it is as good as what he gets from the old oaken bucket in Massachusetts.

Mr. Horace Greeley.—No; he will find lime water in Kansas for the most part, but I am satisfied that the deep water of new countries is not half so sickly as the surface water. The first settlers drink from springs and pools filled with surface water, which contains decayed

vegetation. But if he will dig and get pure water it will be just as healthful though not quite so palatable as Massachusetts water.

Ashes, Leached or Unleached.

Mr. Calvin Mead, Chittenango Falls, N. Y., asks which he should buy, and if old leached ashes are good for anything.

Mr. J. B. Lyman.—The farmers on the line of the New Haven railroad, in Westport and Bridgeport, have bought and used both. Their soil is mostly a cool, heavy loam, full of stones, and natural to grass. They find no difference. A field where leached and unleached ashes have been sowed in strips shows no difference in grass. In the locality of which I speak it is generally applied to grass lands only.

Mr. Horace Greeley.—This may do for the soil of which Mr. L. speaks, but with me, in the upper part of Westchester county, I find leached ashes worth fifty cents a bushel, and unleached not worth more than ten for most crops.

Mr. N. C. Meeker.—It is so much a question of soil that no general rule can be given. On the reddish light soil of Southern Illinois I have found the leached just as good, but on a different soil this might be reversed. All we can say is try it and give us the results.

Mr. Horace Greeley.—Is there not some chemist among us who can tell us the essential difference in the two? Of course we know that leaching takes our potash. Does it remove all the potash or a part only? What remains is slacked lime or silica. Now slacked lime is worth about ten cents a bushel. But if the leached ashes have a chemical effect on the soil so as to release plant food from combinations in which it was locked up, we would like to know about this.

Mr. A. S. Fuller.—Jersey marl contains seven per cent of potash, as ascertained by analysis, which is about the same as unleached ashes, and yet not a particle of potash can be obtained from it by leaching. The plant, however, can find the potash, and so it is likely to be with the unleached ashes.

Chair.—Mr. James A. Whitney will read, in a few weeks, a paper on artificial manures in which he will give us the chemical explanation we need. He is fully able to instruct us in organic chemistry, and I have no doubt the paper will be a valuable one.

Mr. W. S. Carpenter.—We are leaving out of view one important matter in our talk of ashes. I buy a great many every year. In fact it is about the only manure I use on my potatoes, and I buy of the bacon smokeries in New York, because they use hickory wood. I have found hickory ashes a great deal better than pine.

Mr. Horace Greeley.—When I was a boy they used to say that elm makes the best ash.

Mr. H. B. Smith, of Westfield.—Elm may be the richest in potash, I think it is better in that respect than hickory; but hickory has more lime, and is, for some soils, superior on that account. I would by all means advise Mr. Mead to make use of his old ash-heap for manure. The surface may be useless, but the interior is as good as fresh. The ground below it to some depth must contain potash.

Dr. Isaac P. Trimble.—As an illustration of how doctors disagree, Professor Rogers, of New Jersey, used to say our marl was valuable for an ingredient. Now, Professor Cook says it is quite another constituent that makes it so valuable a fertilizer. We have found that it closely resembled the ash of straw, and we think our marl, bushel for bushel, is about as good as leached ashes.

Mr. Horace Greeley.—It makes no difference how much the doctors differ so long as the patient improves. Marl is no doubt an incalculable blessing to South Jersey. I have used it, and found it a most excellent fertilizer.

Deep Plowing.

This subject was brought up by the statement that a barren knoll was made fertile by plowing deep. Several members dissented, and said that no amount of plowing could benefit most sandy, gravely, and worn out knolls.

Mr. Greeley.—There are thousands of knolls and ridges which should never be plowed at all. If, of 100 acres, twenty acres of the ridges, as in many parts of the country, were planted to trees, the remaining eighty acres would bring more grass, and perhaps of grain, than if the whole were under cultivation. It is wonderful that people will talk as they do, as if results do not follow causes; as though fifteen inches of soil were not better than five inches. I do not say that this shall be buried out of reach of the plants. I insist that if land is to be cultivated it should be stirred and pulverized deep enough to furnish moisture during such drouths as we are likely to have every summer. I will take a stand upon the words of Whittier, even if he is a poet:

> "I sigh no longer, for I know
> That when the share is deepest driven
> The best fruits grow."

Mr. Carpenter.—The best corn has its roots within six inches of the surface, and such receive great benefit from slight showers, and from

the heat and light of the sun. If corn is manured on the surface, and the ground is frequently stirred, there need be no fear of drouth. I think that to plow two feet deep is what farmers are not prepared for.

A. S. Fuller.—After this subject was up some weeks ago, I made experiments in planting corn. Across some rows I had the ground dug and stirred thoroughly two feet deep, and now anybody can tell the difference a long distance, for the corn on this deep soil is by far the most vigorous.

Peck's Patent Milk Cooler.

The committee appointed by the club at its last session to make trial of this invention report as follows: We met on Thursday last, the 2d of July, at the farm of Warren Leland, President of the Westchester Agricultural Society. Mr. L. now milks forty-four cows, and has always found great difficulty in cooling the milk which he sends from his farm to the Metropolitan Hotel. The afternoon of Thursday was hot and moist, the thermometer standing at eighty-five degrees in the barn where our experiments were conducted. The animal heat in the milk as it came from the cows was 100 deg. In passing through the tube of the cooler, the vessel being filled with ice-water, the milk was immediately reduced to fifty degrees. Five gallons can be cooled in a minute. Two glass jars, each holding half a gallon, were filled, one with the cooled milk, the other with warm. In two hours there appeared a layer of cream an inch in thickness on the cool milk; this layer continued to deepen in color for several hours, the milk below growing whiter till it became apparent that most of the oily matter in the contents of the vessel was at the surface. In the other can a slight film of cream rose to the surface, and the milk in twelve hours became coagulated. Several gallons were also cooled by this process and allowed to stand ten hours in a tall, tin cylinder, having a glass window fitted in a slat at its side. Here were collected twelve inches of cream at the surface which in ten hours was taken off and churned. The butter came in twenty minutes in a dash churn, was quite firm, of good color, and remarkably fine flavor. The buttermilk was better than any produced in the usual way. Your committee are thoroughly convinced of the great advantage to all who produce and all who consume milk of having the animal heat taken from it *at once.* Thus treated it remains sweet for many days, and makes a superior article of cheese and of butter.

We cannot therefore too earnestly recommend to dairymen to examine and adopt an apparatus by which this result is accomplished so perfectly.

JOSEPH B. LYMAN,
JAMES A. WHITNEY,
WM. S. CARPENTER,
Committee.

Horace Greeley.—Will the patentee state the price at which this invention can be afforded?

Answer.—At from six to fifteen dollars, according to size and finish.

Propagating Boxes.

Mr. C. F. Pearce, Assonet, Mass., sent a package of boxes for gardeners to set out plants, which open at the side, and the plants are removed without disturbing the roots.

Metallic Sack Fastener.

Mr. L. H. Gano exhibited this article, which is made of wire, and is attached to the sack by means of a small iron lever.

Milk Shelves.

Mr. E. B. Slocum, Grass Lake, Mich.—Erect a post, say four inches square, in your milk room. About two feet from the floor, nail one lath on the post in a horizontal direction; then, on the opposite side, nail another lath the same way, letting the lath extend far enough from the post to set a milk pan upon each end. Immediately above and close to these laths nail two more laths in a similar manner, but in opposite directions. You will then have a tier which will hold four pans. Eight inches above this, then eight inches still farther, and so on. One post can hold twenty-four pans.

Vinegar.

Mr. E. Munson, Sennett, N. Y.—Will you inform me the speediest method of making vinegar out of new cider? Would a new pine cask affect the taste?

Mr. N. C. Meeker.—If cider is made from early apples in August, or the first days of September, and put in a warm place, it will turn to vinegar in a few weeks. If made after the nights get cool, it will take several months, or, if placed in the cellar, years, but when it comes it will be good. A pine cask, unless strong with pitch, ought

not to make the vinegar taste any more than bugs, worms and tobacco cuds in the apples.

Profits of Poultry.

Mr. W. C. Ludd, Vermillion, Erie county, Ohio.— From fifty-six hens, fourteen males, we had, in three months from January, 225 dozen eggs, at thirty cents per dozen, sixty-seven dollars and fifty cents; cost of feed twelve dollars. As the hens were worth twenty-five cents each, this is a profit of 370 per cent. I feed liberally a mixture of corn, oats and buckwheat, pulverized raw bone, shell and pure water always accessible. Also feed refuse meat and vegetables; also, a mush of provender and refuse scraps from the kitchen, scalded in slops or sour milk. The fowls have a plenty of room, and warm quarters in a conveniently arranged hennery. Nearly every leading variety is superior to others in some one respect, and I am satisfied that "blood" pays as well as in other stock. In the care of no kind of stock is the maxim of "what is worth doing at all is worth doing well," more applicable than in the management of poultry.

Poultry Raising as a Business.

Mr. S. Edwards Todd.— One of the first questions that occurs to the amateur farmer (by which word we mean the man who makes better crops on paper than he does from the soil), is whether there is not more money for the labor in the egg and chicken business than in most other country modes of industry. *The World* has received many letters of inquiry on the subject, and on the first of last January the American Institute suggested that letters giving accounts of profitable gangs of hens, the cost of raising chickens and of producing eggs, would be acceptable.. These questions were responded to, and many accounts were received of the profits of keeping twenty, forty, fifty odd hens. But no reports from large poultry yards were received. Nobody could give an answer to the question whether 500 hens can be kept on one farm with profit. In fact, it has been supposed to be well nigh settled that chickens kept in great numbers are not apt to do well; that a poultry yard has a natural limitation, and that failure is likely to attend an enterprise of such proportions as to make poultry raising a business. If any man proposes to himself to go boldly into the chicken line, we cannot give him better advice than to visit New York, stop at the Metropolitan Hotel, make the acquaintance of its incomparable landlord, Warren Leland, and go with him to visit his

great milk and poultry farm in Westchester county, midway between Portchester and White Plains. A day at the Metropolitan will satisfy him that the proprietor knows how to keep a hotel; a day at this farm would convince him that its owner knows as much about the poultry business as he does of the art of public entertainment. In short, Mr. Leland has settled the question as to poultry. He has proved by years of complete and unbroken success that one can be a great chicken raiser just as easily as he can be a great wheat grower; in fact, much easier; for the poultry business requires only a trifling outlay to begin with. Mr. L. has never troubled himself to keep a nice account current with his hens. Their layings are not set down in a book, nor does he know just how much corn they all eat in the course of a year. Hence we look rather at the gross results than at precise figures. He devotes about twenty acres of rough land to his poultry. For tillage this range would not be worth much, but for chickens and ducks it is just the place. He lets the bushes grow and leaves a pond for the ducks. The turkeys have woods to range in and trees to roost on. In summer, the only rule is to give freedom, ample freedom, to all the tribes, a suitable lot or pond for ducks, a natural range for turkeys, hill sides, bushes, nooks, shelters, hiding places of all sorts for hens with broods. He discards coops altogether this year, finding no advantage from them, has no high fences, no bars and bolts no fetters or jails for his domestic birds. The wings of the geese are not clipped; the toes of the hens are not mutilated; if the turkeys want to fly they may; the more natural freedom he gives, the more healthful and profitable he finds them. The principal features in his system may be condensed into four short rules: First, in summer give freedom and grasshoppers; second, secure cleanliness; third, feed well; fourth, change cocks every spring. For the winter comfort of this feathered stock he has two houses; one of stone, the other of wood. The wood house is the oldest and the cheapest. He has had better luck with it than in the more expensive structure of stone. Lime and plaster are freely used in all parts of them to absorb smells and compost droppings. They roost on poles near the roof, and three or four feet below is a wide sloping shelf covered with plaster. This is swept off once a week, and the contents put in barrels, mixed with all refuse, feathers, filth and bones from the yard. It makes corn grow, and colors it a dark green. Another rule of great importance: No old nests are allowed. When biddy becomes a mother, the box where she incubated is taken out, the straw

burned; it is whitewashed inside and out, and allowed to stay out in the sun and rain some days, then half filled with clean straw and returned. There are banks of soft, fine dirt where the hens go and disport themselves, for hens are so curious, the cleaner you keep them the fouler they become; perhaps they would not be fowls if this were not so, and a clean, smart looking hen with smooth glossy feathers is sure to take a dirt-bath every day if she can get a chance. There are fireplaces in both the houses where wood is piled when the mercury goes down about zero. In warm days the hens go down and scratch out the ashes and shake them into their feathers. Herodotus says the old Jews took lessons from the domestic fowls, and piled ashes on their heads in affliction as they saw hens do. As to breeds, Mr. L. finds the black Spanish the best for eggs but worthless for the table. For eating, he says we must take an Asiatic chicken, the Brahma, the Cochin, or the Shanghai. He produced a great many eggs, of course, but the greatest profit he finds from chickens. For instance, each of the 250 hens he has in early spring may, if so disposed, have one brood a year. As she leaves the nest, four or five of her feathered sisters will have young families the same day. The hen who appears to be the best mother among them, the large, matronly, dignified biddy, who has a loud cluck and a composed but guarded manner, is selected as the mother and nurse of all that day's hatching. She goes about proud, conscious, and responsible, marching at the head of a platoon, thirty, forty, or fifty strong. The bereaved hens have a cold bath, are shut up a few days to a solitary struggle with maternal instincts, and then return to the harem and the nest. About the middle of June he begins to eat spring chickens. If a hen comes off early in April with ten chicks, by the middle of June they will weigh twenty pounds, five dollars worth of chickens a year. The eggs pay for food and attendance, leaving the sales of poultry clean profit. Mr. L. says he can produce 1,000 pounds of poultry cheaper than he can the same weight of mutton, beef, or pork. He finds as much profit from turkeys, and often greater than from hens. They often require more attention, but some years he has fifty to sell for which he gets five dollars each, besides a great many more for which he gets from one to three dollars. Just now he has 3,000 young chickens, several hundred young turkeys, 200 hens laying every day, or hatching broods, and handsome platoons of ducks and goslings, probably about 4,000 in all, of domestic fowls, each of which on an average is or

will be, by thanksgiving, worth a dollar. Deduct from this the cost of 200 bushels of grain, and the hire of an attendant, to whom he may pay $250 a year and board, perhaps more. They eat up the grasshoppers, grubs, worms, eggs of insects, larvæ, beetles, snails, katy-dids and June bugs so clear that his farm is less beset with pests than most others about him. He has apples when others are ruined by the borer, the caterpillar, the tent worm, the canker worm or the curculio. Another advantage, his cocks begin to crow about 3 o'clock, and everything in the place is out by sunrise. One can eat a breakfast of spring chickens by 6 o'clock. He is obliged to drain all ponds about the place at intervals, in order to kill off the snapping turtles that eat his young ducks. The rich ammoniacal manure from his hennery enables him to grow about the biggest corn of any farmer in Westchester; he keeps a great stock of cows, saves all their droppings in cellars, spreads it on meadows, so that from twenty acres he can cut sixty tons. Nobody around him can beat that; hence for this and other good reasons Mr. Leland has been elected president of the Westchester Agricultural Society. This is a distinction he deserves, if for no other reason, because he is the only farmer in the country that keeps poultry on a large scale and derives a profit of thousands of dollars annually from it, and others can do the same. There is no witchcraft or luck about it. Consider his management, and one sees that it is simply sensible and thorough, but how many owners of little, rough farms there are all around New York in every direction that could have every facility that Mr. Leland has! This is a line of development that has never been encouraged or rewarded. Will not Peter Cooper, or Horace Greeley, or Warren Leland himself offer a premium to the man or the woman who sends to market the greatest quantity of eggs and poultry from a given number of hens?

SCAB IN SHEEP.

Mr. Diehl, the Asiatic traveler, inquired if there is a remedy for this disease which is prevailing in many parts of the country to a great extent.

Mr. N. C. Meeker.—Cresylic ointment is recommended as a specific in destroying the germs of infection of whatever character. So far from this disease being new, it was common thousands of years ago. It is principally confined to large flocks, and is seldom known where only enough sheep are kept to supply the wants of a family. Disease and disaster attend large herds of animals and most enterprises.

Romeyn Seedling Strawberry.

Mr. Foster, Kingston, N. Y., exhibited specimens of strawberries from a plant of Romeyn's seedling, to prove that it is later than the Wilson, and he stated while the Wilson is gone, this will last a week longer. It is large, showy, and productive, and if it will bear shipping, it must come into general favor.

Mr. Wm. S. Carpenter spoke highly of the Agriculturist, and that it is more profitable with him than any other, and that he preferred any kind to the Wilson. Adjourned.

July 14, 1868.

Mr. Nathan C. Ely in the Chair; Mr. John W. Chambers, Secretary.

Originator of the Rose Potato.

Mr. Solon Breese, Hortonville, Vermont.—Mr. Hefron did not originate this potato, but Albert Breese, of Rutland county.

Potato Slugs.

Mr. J. H. Lovejoy, Oxford, N. H.—I find in my garden potatoes yellow worms, with dark brown heads, which keep in groups near the ground. They hatch flaxen colored eggs, and increase very fast.

Mr. A. S. Fuller.—This is the potato slug, which is well known and is in my grounds.

Apples without Seeds and Cores.

Mr. L. Barrett, Smiksburg, Indiana county, Pa.—Last year I saw such in West Virginia, solid and of good flavor. They do not blossom like other fruit, but put forth stems and buds like a clove. I put in some of the grafts this spring, which are growing finely.

Mr. N. C. Meeker.—This must be the kind of apple that grows with the graft up side down.

Mr. A. S. Fuller.—I never saw such fruit. I would ask Mr. Phœnix, of Bloomington, Ill., who is present, if he ever did. He ought to know.

Mr. F. K. Phœnix.—I never did. Of course there is no such thing.

Breeding from Young Stock.

Mr. A. Dwinwell, Walpole, N. H.—It is the practice to breed from animals of both kinds from two to three years old, while they do not arrive to maturity till five or six years old. To get good stock by

this means is simply impossible. What would farmers think of planting unripe corn? The ill effects of breeding in and in is not so detrimental as this practice. Hardy stock cannot be secured by this means.

Mr. Wm. S. Carpenter.—I have paid considerable attention to this subject. In talking with farmers they differ; but I have concluded that the earlier heifers come in, say at two years old, the better. I think they will become better milkers than if left to come in at a later period.

Mr. J. B. Lyman.—The Legislature of New York appropriated several thousand dollars to investigate the cause of abortion in cows. Dr. Dalton was appointed, and he visited or had reports from 4,000 farmers, and it was not found that early parentage had any effect in producing the disease.

BEET SYRUP.

Mr. H. De Witt, Shuter Creek, California, inquires the best process.

Mr. N. C. Meeker.—The answer is that the only beet works in this country are at Chattsworth, Ill. A considerable sugar has been made. About 600 acres are now in cultivation, and a large sum of money has been spent. It is not understood yet to be profitable; still, a large crop of beets are in the ground this year. There has been decided mismanagement, perhaps unavoidable, and one great want has been a supply of water. Recently a company was organized at Aurora, Ill. A company was partly organized in this city more than a year ago to establish works near the Illinois river; but for some reason, it has not yet gone into operation. The proposed capital was not less than $200,000. The trouble with all such enterprises is that they are often projected by men either without means or practical knowledge of working the soil, and whose central idea is that there is no possibility of failure. Such men are certain to fail, because in all enterprises there is only one right way while there is an indefinite number of wrong ways, and only experience and good sense will find the true one. That beet sugar is destined to be profitably made in this country we have not the least doubt. Government ought to undertake it, as the French government did, and the right man for manager should be carefully sought, and, if necessary, with tears. The services of the men who can make the beet sugar a success in this country would be worth a dollar a minute.

Fence Posts Again.

Mr. Dwight Newton, Robinson, Ill.—Chemists recognize a form of decay in wood called the putrefactive, and another form called "slow combustion." The putrefactive often begins in the standing and growing tree, almost always next the ground, and it generally exists in a uniform degree through a large portion of the diameter. The signs of its existence are often very slight. I have seen workmen using such wood for cogs and spokes, protesting that they were cutting the very best of wood. If kept dry and ventilated it might last a long time. But if fence posts were taken from the butt cut of such a tree, those set butt downward might rot sooner than those reversed, for the reason that the decay would be already most advanced at the lower end when set. This may explain the results of some experiments in reversing. Whether the valves of the sap vessels can reverse themselves in dead wood may be difficult to ascertain. I merely know that such a result could not occur in a dead animal. The best timber for posts is that which is but little subject to the putrefactive form of decay, and at the same time resists well the other form called combustive, which latter is simply rotting on the outside while the interior remains perfectly sound. This kind of rotting of posts *always* proceeds most rapidly at, and just below the surface of the ground, and, of course, if putrefaction does not set in, the durability of the post depends in a great measure upon its size. Just as we see the big green logs in the burning log heap endure longer than the smaller logs. Cedar and some kinds of pine rarely decay by the putrefactive process, and very slowly by the combustive. The same I believe to be true of wild cherry and black walnut, of course in less degree. Whether either process is hastened or retarded according as the circulation of water in the vessels is upward from the ground or downward from the clouds, let the club judge. Having heard the question disputed most tenaciously for nearly half a century, I recoil from it as from the cheat and wheat question.

Asparagus.

Mr. N. H. Perry, Oakville, Conn., asks how and when to make an asparagus bed.

Mr. S. Edwards Todd.—Take the warmest, mellowest land you have, spade it deep in September, and work in lots of horse manure. Also use salt freely, say half a bushel to a square rod. You can raise the young plants from seed, or get roots from a gardener or some

neighbor. Set out early in spring, after a deep and thorough spading. Keep clean and let grow two years if plants are little, so as to get strong roots. Then in the spring of the third year you can begin to cut for your table, but with a sharp knife, slanting. After the 15th June let grow. Cover well with coarse horse manure in winter, and loose between roots with a fork early in the spring.

MILDEW ON GOOSEBERRIES.

Mr. A. C. Weaver, Papin, Wisconsin, asks for a remedy for the mildew on the gooseberry.

Mr. J. B. Lyman.— Dig around the bushes so as to prune the roots somewhat; in the trench thus made mix wood ashes and two quarts of dirty salt; hoe clean all around the bushes and sprinkle refuse charcoal or the dust from charcoal pits on the surface. This has cured all mildew on some soils.

GAPES IN CHICKENS.

Mr. J. B. Lyman.—Gapes are produced by a little white worm in the chicken's throat. The best preventive is to make sure of healthful conditions for the fowls in all respects. They should have free range and an abundance of their natural animal food. Another important rule, change roosters every year. The poultry will be healthier in all respects. Give the chicks a little, and only a little, boiled yolk of an egg when they are a day or two from the shell. Chickens often have their constitutions undermined by being overfed when very young. After they are a week old, feed liberally with a variety of grain, such as cracked corn, barley, oats, refuse from the table, animal food, etc., etc. If a chick does well he will grow half an ounce a day, or a pound a month. As a preventive of gapes stir up their pudding with vinegar instead of water once in a while, say twice a week, and give them a little black pepper. If, in spite of these precautions, you have a chick when he is about the size of a robin breathing as though he had a bad cold and coughing, at the same time opening his mouth as though something choked him, his case must be attended to at once, or he will never grace the breakfast table as a "spring chicken."

Take a small, slender quill, about five inches long, and strip off the feathers on one side. Dip it in a mixture of melted butter and black pepper; holding its mouth open with the thumb of the left hand, carry the feather down the little fellow's throat as far as possi-

ble, twisting it as it is withdrawn. Repeat the operation several times. If done with some skill, the feather will often bring up a small white worm. But the oil and pepper, if well spread over them, makes them feel so sick at their stomach that they let go their hold on the chicken's throat and die. We have cured bad cases with two or three applications.

Cider Vinegar.

Mr. Charles Hammond, Cedalia, Mo., asks how to make cider vinegar.

Mr. W. S. Carpenter.—Let him keep his cider where the air can get to it freely, and then buy some good vinegar, if he has none. Draw two pails out of the vinegar and fill up with cider. Take the vinegar and put it into a cider barrel, and so on, giving a few days after each mixture. In that way one barrel vinegar will operate on twenty of cider, and make it all into good sharp vinegar.

The Weight of Milk.

Sylvester Knapp, of Sayville, N. Y., writes: I would like to ask the club if the heavier the milk is, is it not the richer, and what the average weight of milk is, and what kind of food makes the richest milk? I find, to my surprise, that skim milk is heavier than new milk, and cream is lighter than either. I find that the less milk my cow gives the heavier it is, and it will vary nearly or quite an ounce in a pint from one day to another by changing the feed. My milk weighs from seventeen to over eighteen ounces to the pint, and when it first came in it weighed nearly one and a quarter pounds to the pint. Now, if rich milk is lighter than poor milk, why does milk weigh more than water?

Answer.—To use the simplest language, milk is made up of three parts: The cream, the curd, and the whey. Cream is lighter than water, and the curd is heavier. You can prove that by dropping a piece of common white cheese into water, and then a bit of butter. One swims and the other sinks. The milk of different cows and of the same cow at different times will be found to vary in the amount of curd and in the quantity of butter. When there is more curd, its weight will be increased; when the cream is most abundant the milk is lightest. We call milk that gives thick cream rich milk. It is rich for some purposes and in some elements, but poor in others. As a rule, it is curd that gives size and strength in the system, and

butter that aids digestion and gives warmth. Hence, when the calf is young and needs curd to build up its frame, the milk of its mother is rich in curd. This is the reason why the milk of cows must be diluted before we give to babies. The calf grows a great deal faster than the child and requires more curd in proportion. It is easy to see that heavy milk is best for the cheese maker, and light milk for butter. Winter milk is richer in cream than summer milk, as a rule, because in winter the animal needs the oil for keeping her body warm. Hence snug, warm barns increase the flow of milk and its cream, for the animal can spare more. Cows that naturally give little milk yield an article that is richer in both curd and cream. So about the feed. If you give your cow late cut, coarse Timothy, your milk will weigh an ounce or two more to the pint, because this contains more albumen, of which curd is made. Meal will generally increase the cream. Oats ought to make heavy milk. You have hit upon a line of observation on which some useful facts might be brought out. By changing food and carefully weighing milk the power of different kinds of hay and grain can be measured. A food that makes a heavy milk is best for giving size and strength ; hence best for young animals that should grow fast, and for working animals whose muscles are worn by hard exercise. You will probably find that large, muscular, ox-like cows, like short-horns and Durham grades, give heavy milk, while the lean, scrawny cow yields a light but creamy fluid. As a rule the human stomach does not need as much cream in proportion to the curd as new or fresh milk contains. Hence, butter-milk is more suitable for summer drink than sweet milk. It is the best of all beverages for the hay-field, giving strength as well as supplying fluid. Whey contains hardly any curd and a little butter. Hence it is not a proper food for calves, unless oatmeal is scalded in, or bean meal. This subject is one of no small importance to the farmer, and we hope you will keep on making experiments, for the benefit of more than a hundred thousand farmers who read our proceedings.

SOWING CLOVER WITH WHEAT.

Mr. John A. Richardson, Elizabethtown, N. C.—I respectfully solicit, through the club, information relative to the sowing of clover with wheat. I desire to sow a few acres in wheat this fall, and at the same time, if it be not injurious to the wheat, to sow clover, so that when I cut the wheat I may have the area in clover to turn under. Will it answer to do this? If so, what quantity of clover seed per

acre should be thus sown? The land is not very fertile, yields, ordinarily, about twenty bushels of corn to the acre, has a hard, impermeable clay sub-stratum.

"What quantity of Peruvian guano ought to be used per acre?

"What kind of clover should be sown?"

Mr. J. B. Lyman.—It works well to sow clover with wheat. In the spring, after sowing wheat in October, go over the field and sow twelve pounds to the acre of red clover seed. Some sow on the last light snow and let the seed sink with the melting. This works well. As to guano, 300 pounds to the acre is a good dose; but you must not lean on guano. It will pierce you or your purse and let the money out. It is like whiskey in harvest, a draft of to-day, payable out of to-morrow. Use some guano, but rely on barn-yard compost. That is like charity in one respect, it never fails.

Wild Potato.

Mr. Covenhoven, Painted Post, Steuben Co., New-York, sent five specimens of this root, belonging to the Convolvulus. It resembles in taste the common potato. One of the tribe of the Iroquois nation subsisted upon this root, and thence derived the name of potato tribe.

Mr. A. S. Fuller.—This is the *Glycene Tuberose.* Ten years ago I brought this root to the attention of this club, and urged its cultivation. It grows well, and hogs will root up much ground to feed upon it. It is found in large quantities on the plains, and California immigrants have starved to death where this root could have been dug in large quantities. This fact shows the importance of making botany a study in common schools, that children may early learn the names and the nature of thousands of things beneath their feet. It is a great neglect on the part of the managers of schools that this study is not generally taught.

The Study of Botany.

Mr. N. C. Meeker.—That botany should be taught young people, there is no doubt. It is a disgrace, in this age of learning, that young people should be such utter strangers to the floral and vegetable world. But so long as the science is taught by the present nomenclature it can never become popular. The terms are so barbarous and so unfitted for children or even for our youth that it is in vain to expect other results.

Mr. A. S. Fuller.—I know botany is a dry study, but we should teach by object lessons. When the Latin words are analyzed they show wonderful application. The great fault lies in the teaching. I have known young ladies who had been studying botany two years come on my grounds, and they knew so little of the science they could scarcely tell a dandelion. But I have taken them in hand and given them illustrations in analyzing the words so that they would remember every lesson, and if the subject were followed up they would make astonishing progress. The advantage of the Linnæan system is that it enables foreigners to understand each other.

Dr. J. V. C. Smith.—They have a beautiful system in Switzerland. The boys start out with hammer and basket and their teachers, and they examine every object, flower, rock, and tree, and come to a practical knowledge, such as should be given in this country, and it is a disgrace that it is not given.

Mr. J. A. Whitney.—We are not willing to keep our children at school long enough, and we do not pay salary enough to teachers.

Ox Yokes.

Mr. W. C. McKinbie, Crawfordsville, Ind., sent a small model intended to work easily, and which was offered to compete for the $100 prize.

Mr. P. T. Quinn.—Some years ago I had occasion to use many pairs of oxen, and being convinced that the yoke hurt them, harness was substituted, and they were able to draw one-third more.

Mr. Hyde.—While in the west we use to work eight pair of cattle, and we found that nothing was better than bows of hard, smooth hickory and yokes of maple, for the neck of the ox has a cushion making a well constructed yoke fit easy.

Owing to the extreme hot weather the club adjourned for four weeks, and the next meeting will be held Tuesday, August 11.

August 11th, 1868.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

After a recess of four weeks, a period of uncommonly warm weather, the club assembled in the old quarters in the building of the Cooper Union at the junction of Third and Fourth avenues.

Sowing Lawns.

Dr. Black, Sandyville, Ohio, inquired what time of the year lawn grass should be sown.

Mr. W. S. Carpenter.—In August or September will do. I should sow a mixture of redtop, white clover, and blue grass.

Potato Digger.

Mr. J. O. Davis, Hillsdale, Michigan, wrote to inquire what is the best potato digger.

Mr. W. S. Carpenter.—I do not think there is any I could recommend. I use a two-horse plow with great advantage.

Mr. Wolf then showed a drawing of a digger to be used also as a plow. He said he had sent one to Cuba which is doing good work. A member thought it strange that such an implement should be sent to that tropical island where potatoes scarcely grow.

Mr. N. C. Meeker.—I have seen several potato diggers, and I conclude that when the ground is mellow, free from roots and stones, when the crop is clean, and when the stalks are dead, they will do good work. They are considerably used on Jersey sand, but they clog where there is grass or green vines.

Lime as a Preservative.

Mr. Gardner Hall, Forrestville, Connecticut, stated that he had applied lime to advantage on roofs. Before the staging is taken down, lime is slacked, and a mixture of skimmed milk and salt make a whitewash, which is applied to the shingles with an old broom.

Mr. John Fuller, of Newark.—When I was a boy, twenty-four years ago, I helped to boil sap shingles, made of white pine, in lime water, and I learn that the roof has only required a little patching. Without such preparation these shingles would have lasted no more than three years.

Dr. Snodgrass.—The addition of salt is a detriment rather than advantage.

A. S. Fuller.—The Jersey farmers always apply lime to their roofs, not directly to preserve them, but to prevent moss and lichen from growing.

Mr. Carpenter said he had applied linseed oil and lampblack with good results in preventing the growth of moss.

Romeyn Seedling.

At this point Mr. A. S. Fuller started a discussion by asking if any member could tell the difference between the Triomphe de Grand and

the Romeyn. Large quantities are likely to be sent out this year, and if there is no difference people ought to know it. For his part he could distinguish none. When the Union and the Queen were brought out he showed that they were both Trollop's Victoria.

Mr. W. S. Carpenter.—I have the Romeyn, and I find it the same as the Triomphe, that is, I can scarcely distinguish.

Mr. P. T. Quinn.—Our club has been noted for fair dealing. We have made a report on the Romeyn, and now its value is questioned at this late day. This attack ought not to be made in the absence of the proprietor, who would be able to show the difference. This should have been presented before. If I mistake not my friend, Mr. Fuller, sent out large quantities of the Boston Pine under the name of the Bartlett.

Mr. A. S. Fuller.—It is for this reason I have learned to be on the lookout. I found that strawberry growing in Mr. Bartlett's garden, and for three years I presented it to this club and the best horticulturists in the country, including Charles Downing and several members of the club now present, that they might identify it with a known variety, but they failed to do so, and I named it the Bartlett. I sold only about 5,000. Afterward I sent for the Boston Pine, and knew at once what I had.

Mr. J. B. Lyman.—I feel that this question is sprung on the Romeyn. As one of the committee, I visited the place where it is grown, and found it doing extremely well on thin gravelly soil, while, as I understand, the Triomphe requires a rich, heavy, clay soil. I also saw it on other grounds, and by the side of the Triomphe, which last I was told was worthless.

The Chair.—It seems to me that if Mr. Fuller knew of the identity of the Romeyn with the Triomphe he ought to have spoken before. I would request that this subject be postponed for two weeks, that they who have grown both kinds may give us their statements.

Mr. N. C. Meeker.—It should seem that to raise a suspicion by asking a question in this manner, without any positive facts, is hardly the proper way.

OXEN AND YOKES.

Mr. A. Dwinnell, Walpole, N. H.—I see that the members and correspondents of the club differ materially in regard to the use of yoke and bows. In this vicinity the yoke is, and always has been used, and I see no good reason why it should now be superseded. I

have been familiar with its use all my life, and am convinced that oxen work as easily in it as in a harness. If properly constructed it will in no respect injure the cattle used in connection with the right sort of cart. It is this vehicle acting upon the yoke, and not the yoke in itself, that injures the oxen. The body must necessarily be so constructed as to throw a considerable weight upon the tongue, and through that upon the yoke and the oxen's necks. The least jar is communicated from either wheel, with increased force, to the team; the yoke is jerked with more or less violence, first to one side and then to the other, and the effect upon the oxen must be unpleasant and irritating, if not, as in many cases it undoubtedly is, absolutely injurious. It is little less than barbarous to subject animals to such treatment, and it is to be hoped that four wheeled vehicles will soon come into universal use. Used in connection with such a vehicle, or a chain, I think a yoke is not only more convenient for a teamster, but preferable in every respect to a harness.

Spring Strawberry Crate,

Shown by Mr. J. W. Fletcher, of Centralia, Illinois.—This is a series of coiled springs, similar to bed springs, in the bottom of the crate. The inventor is Mr. Goodall of the above place. They have been in use this season, and were generally approved by shippers. Mr. Quinn thought it of much value when fruit is hauled over rough roads.

The Importance of Using Pumps.

Mr. H. T. Woodberry, Stamford, Conn.—In behalf of housekeepers, the following facts and figures are offered: A common twelve quart pail (containing ten quarts of water), as ordinarily brought from the well, weighs twenty-five pounds. An average family needs at least twelve pailsful, 300 pounds a day, 109,500 pounds, fifty-four and three-quarter tons a year, much of it to be carried in the worst of weather, and when the carrier, warm from kitchen work, is most liable to contract disease from the exposure. Our well is three rods from the house, hence each pailful involved a walk of six rods, seventy-two rods per day, 26,280 rods, eighty-two and one-eighth miles a year. We have put a pump in the kitchen, attached to it a pipe, nearly five rods long, extending to within six inches of the bottom of the well, and now, without exposure, or opening a door, or spilling water on clothing or floor, or tracking in mud or snow, and not least, without a temptation to use water sparingly, can easily bring in five

gallons per minute. After a year's experience of its use, I consider the pump our greatest labor-saver, not excepting the sewing machine, the washing machine, or even the wringer.

BLIND OPENER.

A device for opening and closing blinds, while the sash is closed, by Mr. S. Jewett, Haverhill, Mass., was exhibited. A knob in the window casing, which might also serve as a curtain knob, is attached to a lever, which opens and shuts the blind at will, while the sash is closed. The members generally thought it an important invention. Something similar was sent out a few years ago from Pittsburgh, but it did not go into use, probably on account of defects.

Red and white potatoes on one stalk were shown by Mr. Nyce, which the chair called the Rose and the Goodrich.

TO REMOVE MILDEW—FARM LIFE.

Mrs. M. E. Colville, Granville, Ohio.—I wish to benefit some discouraged housekeeper this hot weather. For, be she ever so thorough and vigilant, there is a chance of finding some morning that all the fine clothes of the last washing are mildewed, and then, oh dear! you can't imagine what a heart-sick feeling it gives one when they do not know what will take it out. Sour milk will not, if you soak the clothes a year, for acid rots the cloth. My remedy is to wet the cloth in soft water, and then rub on plenty of soft soap and salt, then hang out on the line in the sun and air for a few days. This will remove all mildew, no matter how fine or coarse the cloth may be, or if it is linen or cotton. I think the reports of the Farmers' Club of more real value to farmers and farmers' wives throughout the country than all the agricultural papers put together. It has too long been thought that farming required no brains. The time is fast approaching when it will be thought far otherwise. I would not have all become farmers, but they who have the taste or the ability in that direction should be by all means. Farming is hard work unless we bring to it cheerful hearts and willing hands; but is it harder than the close confinement of the workshops, of the counting rooms, or to stand behind counters, or in the thousand and one places where men and women earn their daily bread in cities and villages?

Adjourned.

August 18, 1868.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Open Ring.

This was sent by Mr. Burkholder. It is composed of two rings, one within another, working on a hinge, and when open presenting breaks in the rings, which match together when closed, making a perfect ring. It cannot unclose of itself, and it was commended by all the members as useful wherever an open ring is required, and suited to mend a link in a log chain.

Filters to Cisterns.

Mr. B. Brewster, Red Creek, N. Y., inquired the best way to construct them.

Mr. J. B. Lyman.—Being lately in Pennsylvania among the good farmers, I found the following method much esteemed. The cistern is made in the usual way, then a well of brick is built up in the center. The water filters through the brick into the well, out of which the water is drawn.

Mr. J. V. C. Smith.—In the cities of the southern States cisterns are made of wood, forty or fifty feet high, with heavy iron hoops, placed in back yards, and the water is drawn by a faucet from near the bottom. There are no filters, and the water is clear and healthful, for it purifies itself, and the dirt settles on the bottom, whence, from time to time, it is removed.

Mr. N. C. Meeker.—I am building a cistern, but shall have no filter. I have had filters, and found that no pains were taken to save clean water, and the filters got foul and useless. If the water was let into the filter only when clean it might do, but then there would be no use of one, hence I shall now save no water except after the roof is well washed off. As to the brick well, there would be difficulty in getting brick of the right burn. If glazed they would prevent the passage of water; if soft they would crumble.

Mr. Aaron Stone, of Long Island.—I have a hollow partition wall in my cistern built of brick. First the water passes through sponge, then through gravel and charcoal, and the water is equal to that in a well.

Cattle Plague.

Mr. Busteed, president of the New York Veterinary College, made the following address:

Gentlemen of the Farmers' Club.—For the sake of the country I hope the sudden appearance of a fatal form of disease among cattle may be received as a warning not to be overlooked with impunity. Exemption from disease heretofore is no security for the future. It is the duty of every man not only to provide for his immediate necessities, but for his future wants; indeed, every good citizen is in duty bound to guard the public interest, both present and prospective. The active exertions of the inspectors of the board of health in seeking to prevent the spread of cattle disease were highly commendable. Still, had the disease reached the farming districts, there is not in the board a single veterinary pathologist who could advise you how to treat the disease. A large share of credit is due to the governors of the States for their prompt action in excluding all diseased animals and placing proper restrictions on their removal. As experience has proved that medical treatment is of little avail in affections of this kind, I trust the impending danger may be the means of causing you to reflect on the exposed condition of stock-raisers, dairymen, and agriculturists. Ask yourselves if this disease, or any other dangerous epidemic should suddenly appear, are we prepared to meet it? Have we well educated veterinary surgeons enough for the requirements of the country? or have we any at all? In my humble opinion the time has arrived, not only to think, but to act. England failed to heed the warnings of her veterinarians when the rinderpest raged on the continent. Veterinary surgeons were looked upon as alarmists, and almost deserving of expatriation. The sudden appearance of the plague opened their eyes to the reality of the thing. In their fright and excitement they appealed to the medical profession for help, only to learn, after a month's inactivity and the loss of 300,000 to 400,000 head of cattle and £40,000 spent in useless experiments on the bovine race, that human physicians were incompetent to treat or manage the diseases of cattle. There is no better stimulus to make a man exert himself, both mentally and physically, than to deprive him of his daily food or the contents of his purse; it sets him to thinking; it was the sober second thought that saved England her roast beef. Finding the medical profession ignorant and incompetent to treat the cattle malady (however competent to treat themselves), they appealed to the Privy Council to obtain for them the services of the veterinary profession to aid and advise them how to save their cattle. The government complied with their appeal, and appointed 200 or 300 members of the Royal College of Veterinary Surgeons as

inspectors. By them and them alone was the disease checked and eradicated. Take a hint from the past, and forget not, gentlemen, that the New York College of Veterinary Surgeons of this city, has, during the past six years, repeatedly warned both general and State governments of the approach of this very disease, and we now warn you of the necessity that exists for veterinary schools in every State in the Union, and for a well-arranged veterinary department in the army. However neglectful others may have been, the trustees and faculty of the Veterinary College feel that they have performed their duty to the State and to the public, and that, too, without drawing one dollar from the public purse.

Mr. J. B. Lyman.—Mr. Chairman: For one I feel grateful to Dr. Busteed for coming before us and calling the attention of the whole community to the importance of studying the diseases of our domestic animals, and I offer this resolution: That we tender the thanks of the club to Dr. Busteed, and ask him to leave his written remarks with the secretary that the press may have access to them. Before taking leave of the subject, this is a proper occasion for reminding the community how little any of us know of these matters, and how few we have in the medical or veterinary profession capable of investigating and mastering the secrets of this disease. As a nation we must be prepared to combat maladies of this description. By the law of our geography the animals consumed in the great cities of the seaboard States are grown and fattened in places hundreds and thousands of miles distant. On the prairies of the far west and southwest, a bullock is raised as easily as a chicken. He is driven or taken on cars to the richest parts of the great valley to be fattened, then brought east to be killed and eaten. In passing thus from one section to another he changes his herbage, changes his climate, his water, his habits. Beginning as wild as a buffalo on the savannas of Texas, his liberty is more and more restrained till he arrives in New York a thirsty, battered, frightened, suffering, feverish creature, and in that state comes to the shambles and then upon our tables. Unnatural as this may be, the demands of our advancing civilization must and will be met, and as long as this mode of giving beef to New York continues we may expect to have wasting and frightful epidemics among our cattle. Hence we need veterinary experts, persons skilled in the anatomy, the necessities, and the disorders of horned cattle. Just now for the investigation of this disease we happen to have with us the best cattle doctor in England, and the Department

of Agriculture has acted wisely in employing him. But for the future we should be too proud to admit the necessity of importing a veterinary surgeon when an alarming disease appears among our cattle. Dr. Gamgee now thinks this disorder is produced mainly by the change of grasses and climate in going from Texas to Illinois. The diseases that have afflicted England came in the same way, that is, from cattle imported from Hungary and lower Austria. With the development of our railroad system, the same practice has been introduced here, and with it these ravaging plagues that nobody understands, and no skill of man has as yet been able to anticipate or to remedy.

Mr. N. C. Meeker.—So far from diseased meat being due to civilization, it is due in many instances to rascality. There are butchers in this city who will sell the meat of sick and dying animals raised within ten miles of the ferries. The main cause, however, arises from building up an overgrown metropolis, which cannot in the nature of things be supplied with healthful food. There is scarcely an article of any kind of food which does not loose some of its good qualities during every mile of its transit hither, all of which is at the expense of the growers in the interior. I can buy a prize in a lottery about as soon as I can buy a pound of good fresh butter in our markets. Civilization and large cities such as New York now is, and as it expects to be, are antagonisms. For the good of our country and of mankind there should be numerous cities of moderate size all through the vast interior, which should be the seat of manufactures, and the supplies of food should come from their immediate vicinity. Still, if meat is to be brought hither, it should be butchered where fed, and be transported in refrigerator cars. Then we would hear no more of cattle diseases.

Dr. Isaac P. Trimble.—My impression is that the plague arises from the cruelty practiced on the animals in their transit. In our city of Newark, cattle arriving on Saturday night cannot be unloaded till Monday morning, so sacred do we hold the Sabbath, during which time the animals are seldom fed or watered, and they drop down and die in their prisons. In the cars in which hogs are confined, if pigs come, or if any of their number die, they are eaten by the survivors. State governments and the general government should suppress these enormities with a powerful hand.

Affections of Domestic Animals.

Dr. J. V. C. Smith.—When domesticated animals are treated kindly they become exceedingly fond of the society of those having the care of them. Most of the very strong ones love approbation, and watch with anxiety for an expression of the eye or the sound of a word that indicates an interest in their condition. Some manifest something more than a mere personal attachment for a master. They actually give evidence of the existence of a moral sentiment.

It is among the curiosities of anatomical science that the muscles of expression which are brought together in the human face, are widely distributed over the bodies of the lower orders. A tiger, for example, shows his anger by exposing a frightful row of teeth, with a growl; the horse by bearing back the ears, preparatory to an unmistakable kick; while the cat sputters, raises her back, and turns out her sharp claws that are not to be tampered with in her wrath. A dog in anger, makes known his sentiments nearly in the same way, but welcomes a friend by wagging the tail. He is the only one of a large group that expresses good nature by muscular force. The peaceable disposition of the horse, ass, mule, bull, sheep, goat, deer, rabbits, and swine, is manifested simply by quietude, unless we admit the first to possess a higher degree of intelligence, which is not to be questioned; but there is no play of the muscular apparatus of the face or body that enables him to show it. It is literally impossible to determine by looking at the faces of either of those familiar animals whether they are pleased or offended. They all have the power of exhibiting the passion of displeasure and excited rage, but nothing more, unless it may be found occasionally in a restless cow that gives additional emphasis to her dislike by driving a foot into the milk pail. Collins, the poet, recognized this extraordinay dispersion of the muscles of expression from the face of animals, which are clustered into such limited boundaries in the human face, where every feeling of the soul is expressed in an ineffable language, like writing on the wall, which indicates the workings of the intellect. In a pastoral, Colin, a discarded lover, laments the unhappiness to which fate has consigned him in a characteristic plaint, that expresses the depressed feelings of the melancholy peasant:

> "I call my dog to me, I call him poor Tray,
> But his tail but just waggles, he so pities me."

Throughout the eastern hemisphere those magnificent stallions

which excite universal admiration on account of their beautiful proportions, symmetry of form, powers of endurance, and amiability of disposition, see no scourges. They do not run when the halter is accidentally dropped. When alarmed, the nearer he can get to one of the family—for he knows every individual belonging to the tent—the safer he considers his condition. Instead of vaulting away at full speed, should a rein break, he stops quietly to have it repaired. Little children climb about his legs; others swing at his long tail, yet he loves them all. A swallow of milk from a gourd shell, or something sweet from their little soft hands, establishes the fact beyond disputation, that the law of kindness is better than the rod, even with brutes. Monkeys have the organ of imitation largely developed, which in a state of freedom is mischievously exercised for general amusement. As prisoners, however, the glimpse of a rattan, always held in a menacing position in the hands of an exhibitor, compels them to go through a circle of performances very amusing to spectators. But left to themselves, they never repeat their gymnastic feats voluntarily, as though the object were to become more expert. On the contrary, the noble horse—that brutally treated, indispensable servant of civilized man in all circumstances of life, from the king to the beggar—exhibits peculiar exhilaration at the sound of a bugle, the sweet tones of a military band, or the booming of cannon. How proudly he steps, dressed in brilliant housings. He has no fear amid the thickening carnage of battle till his rider falls. Then bewildered and distracted with apprehensions of danger, he flies for safety where dangers multiply with increasing horror. We put blinders over his sparkling eyes, and then beat him unmercifully if he hesitates to leap blindly over a ditch. Enormous iron shoes, wholly disproportioned to his weight and strength, are nailed to his feet, to weary him quite as much as the burden on his back. If his tail is not sufficiently elevated to comport with modern conceptions of equine dignity of carriage, a terribly painful operation is performed by cutting the flexor tendons every two inches completely in two. While inflamed and sensitive as the apple of the eye, the maimed caudal extremity is held up by weights over a pully, for weeks in succession. This is one of the severe and unjustifiable surgical barbarities to which the horse is ordinarily subjected in this country, before being placed under the care of a tutor who is supposed to educate him for the severities of perpetual slavery under a succession of task-masters, who are graduated by the length of a purse. His schooling begins

and ends with a whip. Under a succession of corporal inflictions, he cannot forget the miseries he has endured, or shun the tortures that may overtake him if he stumbles on a pebble. What a disgrace to a Christian age and to individuals, that such almost unrebuked perpetrations of cruelty to the horse should be permitted even in the open streets of a city. Mr. Henry Bergh merits the thanks of a nation for his lessons of humanity. He opened the eyes of the people to the moral grandeur of being merciful to domesticated animals.

Civilization cannot have reached its maximum till whips are abolished. They are as unsuitable for horses as our fellow man. Doing as we would be done by in all the relations of life, embraces humanity of treatment to every animal associated with us in domestic economy. The Creator governs a universe in mildness, forbearance, and love. If we profit by the divine lesson of example, our happiness will be exalted in exact proportion to our conformity to the laws of love and unlimited kindness. Camel-drivers talk with their patient, vitalized ships of the desert while trudging by their side; and when nearly exhausted by the burden carried hundreds of miles under a burning sun, and often wallowing through heated sands, he sings the most spirited songs in recollection, to keep up the waning courage of the faithful beast. Sagacity is a marked attribute of the horse when left unmutilated to develop the perfections of his nature. The gelding is not susceptible of the high educational training of the fiery stallion. The latter are astonishing performers at the hippodrome. Restless, nervous, and powerful as they are, they may be calmed by soft words. A whip rouses them to maddened desperation. Horse-tamers of the modern school subdue the most furious animals by a quiet intercourse with them in a stable where there are no auditors. They neither flagellate them nor overcome their wildness by severities. On the contrary, they have the art of convincing their dumb pupil he is his particular friend. When that has been accomplished, the changed quadruped requires no repetition of promise made while he was in duress. Ever after the horse keeps his pledge to behave well, remaining gentle to the end of life, even when misfortune places him under the ownership of a reckless, unprincipled savage of a master. It is a wrong custom in our midst to have so much to do with whips, that it gives employment to a very large number of workmen, as a distinct, well-sustained trade. Our horses snap a bridle and run with a carriage because they dread the approach of the driver as often as otherwise. Their speed is increased when unlawfully at liberty, they so dread the

scourge of the lash, which they know will inevitably follow their capture. Fear makes cowards of men, but worse cowards of horses. The only true and successful method of controlling the animal kingdom is by the exercise of kind measures. That monster of gigantic strength, the elephant, may be led by an infant with a string, if tenderly solicited. Even the lion likes to be petted, and that is the time to handle his paws. These observations have no reference to reptile life. Our knowledge of the influence that might be acquired over formidable serpents, crocodiles and other saurians is of a limited character. The history of all ages, however, justifies the opinion that if they are ever made obedient to the commands of man, it must be brought about by good treatment, as under ordinary intercourse with them they invariably assume a defensive attitude. A gentleman in New York is the possessor of a thousand-dollar horse, whose organ of approbativeness is so prominently active he can be coaxed, but rarely driven against his will. When the considerate owner enters the stable the horse greets him with a hearty whinny, his only language, which is equivalent to a cheerful expression of delight. He is at once treated to a lump of loaf-sugar, which the beautiful and sagacious creature knows is usually carried in a vest pocket, for he rubs his nose directly in there. On returning from a drive he expects two lumps. As two are invariably forthcoming when unharnessed, it is unmistakable evidence to the horse that his conduct and efforts were satisfactory. The sight of a whip to that animal would be an insult and an outrage to his affectionate regard for one who looks carefully to his health, security and comfort. Such an instrument of barbarity does not belong to that good man's carriage, and may God speed the incoming day when they will only be seen in museums, to illustrate the conditions of countries that ultimately became Christianized. The stallion and bull have fully developed brains, and therefore possess a higher degree of susceptibility for instruction than emasculated animals. Oxen are never placed in the arena for those disgraceful amusements in Spain, in which matadors and bulls strive against each other in bloody combats. Maimed horses and cattle, like eunuchs, are neither so strong nor so easily taught as those who have never been fashioned to suit the caprices of humanity. They are always more timid, cautious and unreliant, in consequence of a non-perfect development of the brain, which is abridged in power by the operation to which they are subjected, under the false idea that they are more manageable by being thus manipulated. Smaller animals may

generally be governed with perfect success by kind attentions. Not only cattle and horses, but pigs, poultry and all the birds are in perpetual fear of civilized man, because he shamefully and wickedly abuses the sovereignty he wields over them in the use of a lash and a gun. Their dread of man's power seems to be transmitted from one generation to another. Wild ducks, geese, and pigeons invariably become alarmed at his approach, as though conscious of the depredations made on their ranks by the hunter; improperly denominated sportsman, on the reprehensible theory that the pain they inflict with shot and bullets on inoffensive animals, with which they might live on mutual terms of peace and advantage is genuine rational amusement. It is not so in Mahomedan countries, which is a notable rebuke to our boasted progress. There it is not uncommon for forest birds to nestle about the feet of the farmer as he turns up the soil in the field, to pick up vermin, seeds, &c., which are brought to the surface with a plow or hoe. They even permit their beautifully feathered visitors to fill their little crops with the grain they are sowing. Such treatment inspires confidence that once reigned in Eden. "A sower went forth to sow," is regarded as one of the Savior's parables abounding in wisdom and poetical force, whereas it was a scene with which he was constantly familiar. He therefore fixed upon it for the inculcation of a great moral truth. I have personally witnessed the same gentle intercourse between the husbandman and the delighted birds in the very town of Betlehem in which the Son of God first appeared on earth. One shepherd in Austria safely manages an immensely large flock of sheep without the least difficulty, because each one of them regards him as a special friend and protector. When alarmed the bleating multitude cluster as closely to his person as possible. They have learned by experience that ferocious enemies dare not approach when their guardian is near. Very nearly the same exhibitions of confidence are witnessed in the highlands of Scotland, where small dogs are the vigilant assistants of the shepherds. Writers who strictly enjoin a more generous and humane intercourse with domesticated animals are not very numerous. They seem to hesitate, and leave topics incomplete which demand thorough elucidation. No one has boldly become the champion of outraged horses and oxen, and pointedly enough condemned the very general practice and bad effects of emasculation on their intelligence. If the brain is kept down to a feeble standard, so that in a mysterious way its functions

are modified in a very extraordinary manner by that painful operation, we ought not to expect as much from them as when left in possession of all the organs nature provided for them. If the brain is not slightly arrested in development or growth, no one questions the change produced in the nervous system by such inflictions. Animals, therefore, must be reduced in precisely the same degree, proportioned to their physical powers and reduction of cerebral or brain influence, which emasculation accomplishes. It is no part of this essay to discuss the improvements in slaughtered meats, to show how fattening is made easy by following the old practice. When unmolested in the way referred to, all the animals, wild and tamed, may be taught so much and so many things that approach reasoning, as to make them curiosities which are contemplated with surprise and admiration. But we are treating specifically and especially of the intelligence of animals, again repeating the proposition that geldings can only be managed by reason of their instinctive sense of fear, while the uninjured possess a faculty of estimating motives, and form affectionate attachments which others never do with the same extent. If the brain is defective in any respect, impressions are less vivid, not so easily retained, and slower in its operation, because it is an imperfect organ. There is another suggestion in regard to the treatment of domestic animals which addresses itself to the kindly disposed, and with propriety might receive the fostering care of the Legislature. It relates to their treatment when sick or maimed by accidents to which they are exposed. Immense losses of property in cattle and horses are annually occurring in the United States in consequence of the scarcity of educated veterinary physicians and surgeons. Cities of magnitude sustain a few of that class of practitioners, but in the country, a horse doctor is proverbially a vulgarian and an ignoramus. Some of them are not only distinguished for their ignorance in all respects, but they are criminally so in prescribing for that noble animal the horse, of whose anatomy they do not understand the first principles, nor the diseases to which he is predisposed. Extraordinary mixtures, which as frequently given as otherwise, increase the pain and hasten a death that might have been prevented, left to the conservative course of nature. The absurdities of their theories are as ludicrous and ridiculous as their medicines generally are inappropriate and injurious. Our fickle climate, coupled with the hardships to which horses are exposed by reckless drivers, brings on inflammation, fevers, neuralgia, rheumatic soreness, spasms, besides lesions of the lungs, &c., very

analogous to maladies to which we ourselves are incident. An accomplished veterinary practitioner ought to be sustained in all the thriving centers of population. Finally, the subject so imperfectly treated on this occasion is to be received only in the light of an elementary plea in behalf of ill-treated, unappreciated, domesticated animals, and especially horses. Without them our beautiful fields could not be cultivated, nor a nation develop those agricultural resources which are the life-blood of a people. If by commerce we thrive, is it by agriculture we live. It is our positive duty, as it should be our pleasure, to treat those animals associated with us in domestic relations of life with care and kindness. There is a fearful responsibility upon us in that respect, which is recognized by that All-seeing Eye, that watches the falling of a sparrow. We cannot divest ourselves of that responsibility. We are to be the protectors and not tyrants over dependent animals brought into subjection to our wills. They have neither articulate language for pleading for mercy, nor hands for wielding weapons of defense. Our criminality, therefore, at the bar of eternal justice, cannot escape the penalty which follows violations of those laws which are impressed in fading colors on the consciences of all men.

The Chairman.—I consider that cruelty to animals is a greater crime than to human beings, for the reason that they are helpless. Reference has been made to Henry Bergh, the president of the society, for the suppression of cruelty to animals, and I would say that if there are in the region above cushioned seats and arm chairs, he will be addressed in these words: "Friend, come up higher."

Dr. Halleck.—These principles are of universal application. They lie as low as in the vegetable kingdom, and cultivation corresponds to good treatment. One may talk to his strawberries, beans, peas, and beets, as well as to his fruit trees. If the wants of their nature are supplied, they will understand you and delight to grow for you. There is another branch of this subject, and this is regarding children, especially in foreign families. In passing through certain streets I continually hear the whip and the agonizing screams, and I have often gone into the houses and interfered. I hope the spirit of the paper just read will be received as it should be, commencing in the vegetable world and ascending through the various grades of creation up to men.

Dr. Busteed.—The process of Mr. Rary in taming horses is not new, for it was published as much as 150 years ago by Dr. Black.

The plan is dangerous, because in binding up one leg the animal strains immensely with his other limbs, and the hock joint is likely to be injured as I witnessed myself in one case.

PRESERVATION OF EGGS.

Prof. B. M. Nyce exhibited some eggs that had been preserved in his fruit preserving house in this city for seventeen months. They were tasted by the members and pronounced excellent.

THE KITTATINNY BLACKBERRY.

Mr. Williams, of Montclair, the original propagator, showed fine specimens, stating that while the Lawton winter-killed, this was unharmed.

Dr. Trimble.—A friend of mine accidentally covered a Lawton last fall, and among many it was the only one that bore.

A. S. Fuller.—Acres of the Kittatinny were killed last winter on the Jersey sands. They talk about protection, but a neighbor of mine has a patch of Lawton's on a bleak hill and they bore abundantly. Now where is your protection?

Mr. Carpenter.—The past winter has been harder on small fruits and on fruit trees than for twenty years. On my place every kind of blackberry that was not protected was killed. A great mistake is made by too excessive cultivation. I raised a crop of raspberries by working them after the fruit was set. I doubt the propriety of disturbing the roots at all. This business is not well understood.

Mr. Williams.—I have no sympathy with anybody who talks of raising anything without culture. I cultivate well and use plenty of manure. Any other teaching is pernicious.

Mr. N. C. Meeker.—It seems to me that much of this is loose talk. There is no doubt but what the cultivation of all the small fruits in the spring is fatal, for the reason that there is a growth of the plant, or of the wood, which inevitably pushes off the fruit. But after the fruit is gathered, cultivate at once, and thoroughly, until the middle of September, or thereabouts, and then stop, that the wood may harden, and the fruit set, preparatory to passing through the winter unharmed, and to produce fruit the next year. To cultivate late in the season is to fill the plants with sap, and to make green tender stalks and wood, which must winter-kill. Even if they escape the winters's cold there will be little fruit. It is important to cut back the canes of blackberries and raspberries, both to harden them and

to make them throw out laterals. There is no doubt but that mulching is important, if for nothing more than to prevent the growth of weeds in the spring. Last fall was wet, and where land was plowed deep, and the culture good, there must have been a late fall growth, which winter-killed. All these things must be taken into account, and one must consider them according to the changes in the seasons.

Drying Green Corn.

Mrs. Lima Sherman, Canisteo, Steuben county, N. Y.—Shave the corn from the ear, taking care to cut it as near in center of the grain as may be, scraping off what remains on the cob. Butter your dishes, spread the corn an inch and a half thick on each dish, set it in your stove oven, scald it thoroughly, taking care to stir it frequently that it may not scorch. You may now finish drying it around your stove; the oftener it is stirred the sooner it will dry. It should be put up in paper sacks and packed away in a dry place. This mode of drying corn is preferable to the old way of scalding the corn on the ear, as the water extracts nearly all the sweetness and renders it insipid.

Washing made Easy.

From the same.—Soak your linen over night in cold water; put into your boiling water one pint of soft or one-quarter pound of hard soap, add one tablespoon heaping full of saleratus; wring your clothes from the water in which they have stood over night, place them in your boiler while the water is yet cool, boil three-quarters of an hour briskly with frequent stirring, rub them out and scald in clear water; blue and rinse as usual. The suds are excellent for washing calicos, delaines, and flannels, not injuring the color but rather improving it.

Adjourned.

August 25, 1868.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Lime as a Manure.

Mr. E. A. Pierce, Wyoming Co., Pa., asks in relation to the value of lime as a manure, also about mulching, and how it is done.

Mr. James A. Whitney.—I have heretofore stated, lime cannot properly be called a manure, inasmuch as plants contain comparatively little of this mineral. The beneficial effects of lime result from

its chemical and mechanical action upon the soil. In soils rich in organic matter are found various acids which have a strong affinity for ammonia, and generally exist in combination therewith; by adding lime, a stronger alkali, the ammonia is expelled and is thus made available to plants. In other cases, as for instance in land recently drained, the acids may exert a positively injurious action upon plants, and in these cases the lime, by simply neutralizing the acids, benefits the soil.

No general rule can be laid down for the use of lime; for in one soil it may act in one way, while in another, even on the same farm, it may act in a very different manner. The reactions of lime on the various constituents of the ground are very many and very different, and one reason why chemistry has not been more effectually brought to bear in farming is that people lose sight of the fact that even slight changes in circumstances may wholly change the results of any given mode of treating the soil.

Dr. Isaac P. Trimble.—As an instance of the effect of lime on some lands, a friend of mine in Salem county, N. J., put 1,000 bushels on a bog meadow. It produced magnificently for many years. The same amount on a common upland would have ruined it.

Mr. J. B. Lyman.—Mulching means covering the soil around the roots of plants with straw, sawdust, weeds, or salt hay, so as to protect the earth from excessive heat or cold. It operates beneficially by hastening the decomposition of minerals, and the preparation of plant food in the soil and by keeping down weeds. For strawberry plants it is peculiarly beneficial. Straw, &c., may be applied any time when the drought is considerable. Strawberries should be mulched all the spring, till they have done bearing, especially if late fruit is desired.

How to Peel Peaches.

Mr. J. V. Vanzandt, of Louisville, Ky., informs the club that if peaches are dipped for one second in hot potash and water, the skin will come off at once, without injuring the taste of the peach at all. He uses Babbitt's preparation of concentrated lye, and dips the peaches into the preparation in a wire basket.

The regular paper of the day was then read by Sereno E. Todd, on

FLORICULTURE.

What are flowers good for? What could they have been created for? is a question that we hear repeated from youth to hoary age.

To the great mass of people who entertain such an interrogation, flowers may be spoken of as noxious weeds; as plants good for nothing. Then, as we begin to rise in the scale of manhood, we can begin to think of framing an intelligent answer, that flowers are good for pestiferous goats to eat. We, who attempt to cultivate flowers in the populous city of Brooklyn, where we are sure manhood is developed as far as the goat element, can positively affirm that we know flowers are good for something for goats to eat. We have frequently such positive and occular proof that flowers were not formed in vain, that we can say positively, *we do know*, that flowers are good for *something*, Advancing a step beyond this position, where sight is lost in faith. we tremblingly suggest that flowers were not formed in vain, because they are *beautiful*. There is power in beauty. Therefore, the tiniest flower that blossoms in the noonday sun is a thing of power. The Creator has numerous forms of power; and the beauty that responds to an educated eye from the petal of many hues, is a power that can move the world. There is beauty in a crystal tear drop; and it is balanced only by a mighty "power behind the throne." There is beauty in the glowing sunbeams, and who can compute the power thereof? "A thing of beauty" has not improperly been called "a joy forever."

THE COLOR OF FLOWERS.

Comparatively few persons ever think that the exquisitely rich and velvety hue of our most beautiful flowers can be improved by anything the florist is able to perform. Choice pabulum and coloring matter for growing flowers is something that is seldom thought of, even by many people who appropriate much time and money to improve their flower gardens and to develop and perfect costly and beautiful varieties. Good farmers understand that in order to raise a good crop of wheat the soil must be fertilized with certain elements which the wheat plant will take up and appropriate to the development of the stem, leaves and grain. If the land be manured with strong manure, or with a fertilizer that is composed more largely of carbonaceous matter than of nitrogenous and aluminous and silicious material, the product will be a heavy growth of straw and a very light yield of grain. The wheat plant must be supplied with certain mineral fertilizers that will develop the ears and swell out the kernels of wheat, thus producing a bountiful yield of grain. If the land be manured with strawy compost, or with manure which contains more

muck, vegetable mould, or straw than anything else, the crop will be straw. The wheat plant is the most fastidious feeder of all the cereals. If the land is not supplied with appropriate pabulum, it is folly to attempt to raise wheat. This is precisely the case with many of our most beautiful and delicate flowers. The growing plants are not half fed. Those exquisitely gorgeous petals we often so much admire for their wonderful beauty, are meagre, and inferior to what they would have been if the growing plants had not been starved. Even growing flowers may suffer from starvation, as well as a cow at a straw stack. Plants cannot bring forth beauty out of nothing, any more than the dyer can deliver us beautiful garments dyed in richest purple, or scarlet, or crimson, without the necessary materials, all of which must be supplied to the soil for producing rich colors. We all have seen many flowers which look pale and wan, because the careful florist never has thought whether the growing plants could or could not extract the rich velvety hues of the *lilium auratum* from such material as had been supplied to the growing roots. These considerations lead us to the inquiry as to the *requirements* of flowers, in order to develop more beautiful and gorgeous petals. Those persons who have observed wild flowers growing when the soil is filled with iron and sand and a liberal supply of humus, or vegetable matter, never fail to remark the unusual beauty and richness of the petals. During my ramblings in the unimproved regions of south Jersey I have often been surprised to see what a difference there is in the beauty of the flowers that blossom in the lonely forest, wasting their fragrance on the desert air, and many of the same varieties that are cultivated with extreme care in costly gardens, especially where those in the wild woods sprang from a sand bank in which there was an abundance of iron and some muck. Taking the hint from these observations of flowers in their uncultivated state, we are able to make a practical application of the knowledge thus gained in bringing out far more beautiful flowers than we have been accustomed to produce. Flowers of all kinds require iron for coloring matter. For this purpose iron turnings and iron filing, which may be obtained gratuitously at the iron founderies, will be found of great value, in supplying one of the fundamental requirements of growing flowers. The oxide of iron—those dark colored, thin scales which fall from the iron when blacksmiths hammer the heated bars—are more valuable as a dressing for the soil where flowers grow than Peruvian guano; because such substances supply dame nature with an abundance of

coloring matter. Oxide of iron, or iron filings, or iron turnings furnish the growing roots of flowers with the material for bringing out all the colors of the rainbow. Go ask the artist if he can bring out those colors of transcendant beauty without carmine or rose-pink? Iron will supply the necessary material for decking the petals of lilies and other flowers with the rich colors and roseate beauty. Pile on the iron filings, then, where the roots of growing flowers can reach them; and instead of pale and faint hues, dame nature will excell any of her former productions by arraying every petal in the most gorgeous colors. Send a boy to the iron turner's lathe to get a pail full of the turnings and filings which he casts into the street, and scatter a handful or two, or even a small shovel full around each stool of flowers, and dig them into the soil. In a few months the iron will all be dissolved, filling the soil with just such coloring material as the flowers must have in order to adorn the petals with such heavy coats of silk and velvet as will feast the educated eye. Another article of prime importance in the production of beautiful flowers is sand, or silica. Can a glass maker make glass of any kind without sand? Neither can dame nature develop plants without silicic acid to do it.

Value of Soap for Flowers.

Almost every family uses from one to three or four barrels of soap annually. Besides the large proportion of oleaginous matter of which the soap is composed, there is a large percentage of alkali, or potash, which all intelligent cultivators know is a valuable material to apply to the soil for the production of crops of any kind, either of vegetables, fruit, grass, or grain. Every growing plant needs potash. Consequently there is little danger of applying too much to any land. There are about 300 pounds of soap in one barrel, and it is worth more, pound for pound, than the choicest quality of Peruvian guano, to apply to flower beds, to growing potatoes, turnips, grain, grass, or to any kind of fruit trees. Now, then, suppose Biddy, or your bosom counselor, were to empty one or two barrels of soap into the yard, or the street, or to chuck a hundred pounds of bar soap into the sewer, she would be sharply reproved for such a prodigal waste of the most valuable kind of fertilizing material. But, after a barrel of soap has been dissolved in the washtub, its value, as a fertilizer of the soil, is not depreciated in the least; but rather increased. Therefore, if a barrel of soap be worth

fifteen dollars for fertilizing the soil before the soap has been dissolved in water, surely it is worth more than that sum to apply to flower beds, or to any other plant after it has been employed for making suds. Soap suds, then, is one of the most excellent materials that can be employed in the cultivation of flowers of any kind, from the trailing arbutus, that often opens its tiny petals beneath a sheet of unsullied snow, to the gorgeous Japan lily. Growing flowers need potash. Soap suds will supply that material in the most desirable form. Flowers must have supply of silicate of potash to give the petals that sparkling life-like brilliancy which they possess; and this material can be supplied in no other manner at so cheap a rate as by saving and apply the soap suds of the kitchen, which costs nothing but a few moments employment, when one has nothing to do. Sand, or silicious material and potash, supply to growing plants substantially the same material that potters employ to glaze their earthenware. If growing flowers can have access to soap suds, or unleached wood ashes and sand, the roots will manufacture a glossy solution which will be spread evenly over the surface of the stems, rendering them stiff and glossy, thus covering the entire plant—petals, sepals, stems, and leaves —with an impenetrable coat of mail, which will fortify every part against the insidious attacks of mildew or minute fungi. But if strong soap suds be applied directly to leaves and stems, there is danger that the alkali may injure the delicate tissues. For this reason the caustic liquid should be washed off with pure water.

It will pay satisfactorily to save all the suds on washing days and have the liquid applied to the flower beds after sundown. By this means fertilizing matter will be added in a liquid condition, which is true form for manure of all kinds to be mingled with the soil. Whatever may be applied in a solid condition, whether it be bone dust, guano, superphosphate or barnyard manure, the fertilizing particles must first be dissolved before the roots of growing plants can avail themselves of any advantage from the dressing.

THE BEST SOIL AND COMPOST FOR FLOWERS.

Wheat, and all kinds of fruit trees need more or less aluminous matter for their perfect development, while flowers require, as has previously been stated, silicious material, a bountiful supply of ferruginous matter, potash, and carbonaceous material, in as great abundance as if the stems were to yield luscious fruit. The carbonaceous material which is so eminently essential to the perfect development

of beautiful flowers, may be most conveniently supplied in the form of leaf mould, or swamp muck, which will yield more carbon than it will of any other element.

We have now the ingredients required to form one of the best kinds of compost for flower beds that was ever employed. And one of the most satisfactory recommendations of such a compost is its extreme cheapness. A ton of it can be made in most localities for nothing, except the labor of one man for a few hours. Procure a wagon load or two of leaf mould, fine swamp muck, or black and fine street dirt; spread it a few inches thick on the ground, rake out all the course tufts of grass and sticks; mingle with the mould about one-third its bulk of sand; add several bushels of iron turnings and iron filings, ten bushels of wood ashes, and ten of coal ashes sifted, and a few bushels of slacked lime will do no harm. Let this mass be raked over, at least every month during the growing season. By forking it over, every noxious weed will be destroyed; and by the following season a mellow compost will be prepared that will be exactly what all flowers need for developing stems and leaves in the most admirable perfection, and petals of exquisite beauty. If the compost heap was to receive all the soap suds of the kitchen, for a year, the pabulum for flowers will be largely increased.

The Voice of Beautiful Flowers.

Beautiful flowers teach us instructive lessons of the grand purpose of our existence when they bloom in an obscure corner, shed their perfume on the ambient air, and then return "earth to earth and dust to dust." They afford beautiful commentary also, on the demise of him or her who has lived to love and be loved, but who now sleeps embalmed in the memory of loved ones who mourn for the departed. When the bright queen of spring unlocks the icy fetters of stern winter, casts her robe of beauty on the trees and flowers, and leaves her perfumed breath in every breeze, the beautiful flowers lift up their heads and open their petals to teach us of a triumphant resurrection from the gloomy and silent night of the grave, and of a glorious immortality for the virtuous and the pure. When we meet a poor blind person, moved with pity and sympathy at his calamity, we instinctively give him or her a wide path. Notwithstanding all our boasted wisdom, we look through a glass darkly; and who dares to affirm that, when the spirits of bliss bow their swift wings on messages of love to earth, they do not dodge *us*, blind guides, as we

turn out for blind Bartimeus? That they do not linger among the flowers and regale their angelic natures with the transcendant beauty that *we* behold with our sluggish vision? We banquet on tangible material fruit, which is soon consumed and disappears. And it affords a certain part of our nature unspeakable delight to gaze on the beautiful flowers. They are inspiring teachers. The gaudy colors of the beautiful petals dispel the gloom of solitude, and cheer our lonely hearts like the presence of congenial companions, and lift our earthly thoughts on the wings of devotion and love. The immortal Smith says:

> Were I, O God, in heathen lands remaining,
> Far from all temples, altars and divines,
> My soul would find in flowers of Thy ordaining,
> Priests, temples, shrines.

With our benighted vision we are sometimes unable to see the utility and to appreciate the exquisite beauty of rare flowers. Yet, there are a few things, just a few, that we are able to appreciate, and to understand in part. We have a nature that, when properly trained, educated, and developed, by cultivating flowers, lingering among them and with them, becomes more and more refined. Cultivating flowers, companionizing with them, and talking with them, lifts us up out of the uncouth nature of boorishness, and refines and elevates the whole man, just as the science of music refines, elevates, and polishes, where a coarse exterior has heretofore eclipsed the moral beauties that music only is able to unfold. We have a nature that feasts upon the fruit.

Is it or is it not possible that beings *may* exist, whose chief subsistence is the *beauty* of the flowers, the *beauty* of the rainbow tints, and the glowing sunbeams?

I once heard an illustrious philosopher say: "You may talk to your growing beans, talk to your peas, and any of your vegetables, and there will be a response from those growing plants, if the faithful cultivator acts well his part." Surely, then, they who love flowers may companionize and talk with *them*, and through their angelic influence rise in the scale of intelligence, and learn from their terrestrial teachers to become wiser and grow better from day to day. Flowers teach us also the source of our being.

> "In reason's ear they all rejoice,
> And utter forth a glorious voice,
> Forever singing as they shine,
> The hand that made us is divine!"

The essay of Mr. T. was much complimented by Dr. Smith and others, and a copy of it requested for use by the press.

Mammoth Squash.

Mr. W. Ingersoll, Jersey City, exhibited an enormous squash which had grown in twenty days. Being a beginner in farming, he thought he might challenge old cultivators.

Hand Corn-Husker.

Mr. Gorton, Peekskill, N. Y., showed this invention of his, being two flat forks, sharp at the ends, and fastened together by a spring, by means of which the thumb and fingers are saved from injury. The device appeared as if it might be a valuable one; but a practical test is required, as with all such things.

Broadcast Seeder.

Mr. C. W. Tothaker, from Ohio.—This weighs about six pounds, is not complicated, and it sows grain of all kinds, from the coarsest to the finest, equally well. The spread is from thirty to sixty feet, and it throws low. It works as if one were playing on a fiddle; and as the exhibitor walked two and fro across the stage, telling his story and drawing the bow, he created much amusement. Of the great things the machine will do, he said a boy had sown fifty bushels of oats in five hours. This the gentlemen and ladies thought was good farming; but those whe had walked over thirty or forty acres of ground thought the boy uncommonly smart, or that there was some mistake. Still, the machine was commended without dissent.

Romeyn Seedling Strawberry.

The Chair said that two weeks ago Mr. Fuller had raised the question as to whether there is any difference between this variety and the Triomph de Grand. Mr. Romeyn had sent a long reply, from which the Chair read extracts to the effect that being a seedling of the Triomph it would naturally be similar, but that in cultivation it is found to grow where the Triomph will not, and that the plant is more vigorous. Chas. Downing had called it the best strawberry he knew. Mr. Foster, Kingston, then exhibited several plants of each kind in tubs, and on examination a difference in vigor, as claimed, was presented, but not in the appearance of the leaves or stalks. The points of difference claimed are, that the Triomph will flourish only

on rich shaly soil, such as along the Hudson river, or on Knox's grounds, being worthless on sands, while the Romeyn uniformly does well on all kinds of soil, and in particular at Kingston, where the land is so sandy and poor that the Dutch gave it the name of "poor farms."

It was thought singular that the objector should have condemned it at first as sour, and no better than the Wilson, and afterward claim that it was the same as the Triomph, which he described as the best strawberry grown. Nor does it look reasonable that the Triomph, so well known, should be offered with another name, nor that Chas. Downing should not have detected the difference. Still, it is a question definitely to be decided hereafter; and if it shall prove to grow on all soils, as well as the Wilson, it will be proved not to be the Triomph, and to be a great acquisition.

Dr. J. E. Snodgrass, one of the committee, insisted that the points of excellence as compared with the Triomph de Grand are strong, and place the question beyond a doubt.

Mr. J. B. Lyman said the circumstance that convinced him that the berry was a new one is the fact that so shrewd and thrifty a nurseryman as Valentine Bergoin has been growing the two side by side, and so much prefers the Romeyn that he will plant no Triomphs another spring. He says the Romeyn sells as well and is much more productive.

Mr. N. C. Meeker.—Mr. Gerow, a gentleman in whom I have great confidence, tells me that he has the two, side by side, and finds them different in size, in figure, and especially in the color and flavor of the pulp.

Mr. A. S. Fuller.—There, that's in point. I can understand that. I was going to bring a number of varieties here and show the marks of difference between them. I did not spring the doubt from any wish to injure Mr. R., or check the flow of his orders.

Mrs. Halleck, Milton, Hudson river, thought something should be done to remove the suspicion thrown upon the Romeyn, for as it had been grown on her grounds she considers it more valuable than the Triomph.

Report on Brown's Hay Cutter.

The committee, appointed by the club, repaired on Wednesday last to Newark to witness the operation of the machine patented by Messrs. Brown and Miller, for cutting, crushing and pressing hay.

We found the arrangements and devices for accomplishing this object of the best and most effective character. Two tons an hour, or twenty tons a day can be prepared for the food of animals in a superior manner. The machinery and its operation may be described as follows: The hay is carried by an endless belt to a rotary cutter, which, acting in conjunction with a fixed leger-blade, cuts the hay into pieces from three-quarters to one and one-half inches in length. The cut hay falls into a chamber from which the air is exhausted by a fan. The current of air thus withdrawn removes the dust, dirt, etc., which are carried thereby into a separate room. After being thus cleaned from dust, the hay is carried by a feeding device, between two crushing rollers, which press it flat and softens its texture; from the crushing rollers the hay is carried away by an endless elevator to a powerful press, where 250 pounds of hay are put into a space of nine cubic feet. We do not regard the invention as valuable to the general farming community. The machinery is expensive as well as effective; but for those who handle hay for commercial purposes it is of the first importance. It permits the city consumer to dispense entirely with apparatus for cutting. It insures him a clean, soft article, free of dust, at a moderate cost. It enables the shipper to send hay to market in more compact form, and perfectly protected from the weather.

J. B. LYMAN.
JAMES A. WHITNEY.
S. EDWARDS TODD.

The report of the committee was accepted, the Chair adding some remarks on the value of the process to city consumers.

Adjourned.

September 1, 1868.

Mr. Nathan C. Ely in the chair, Mr. John W. Chambers, Secretary.

Green Manuring.

Mr. W. P. Payne, Clinton, New York, inquired the best method for manuring an orchard, where stable manure could not be easily obtained. He had practiced sowing rye and turning it under.

Mr. James A. Whitney.—Green manuring acts in two ways to enrich the soil; first, by simply returning to the soil a quantity of carbonaceous matter, the decomposition of which affords carbonic

acid, which in its turn is absorbed by the leaves of the plants of the succeeding crops, and also acts to some extent in dissolving the minerals in the soil. This is about all the benefit that results from green manuring with shallow rooted plants, like buckwheat and rye. The deep rooted plants, like clover, enrich the soil in addition to this by bringing up mineral constituents, like potash, etc., from the subsoil, where they would not otherwise be reached.

Mr. A. S. Fuller.—Why not subsoil, in the first place, and bring up these substances in that way.

Mr. James A. Whitney.—Because this would bring up many substances that we don't want brought up. For instance, in those subsoils that contain peroxyd of iron, together with organic matter. The decay of the organic matter abstracts oxygen from the peroxyd, and converts it into what chemists call a protoxyd. This is very hurtful to plants, and if brought to the surface would do more harm than the other results of subsoil would be likely to do good. Besides, clover roots will draw up fertility from the subsoil a great deal cheaper than you do it with a plow.

Mr. N. C. Meeker.—Some members, horticulturists, are saying in an undertone, that clover is the best thing for an orchard. Now, let us know distinctly whether it is proper to sow a young orchard with clover, or is it not. Hundreds and thousands want this question answered.

Dr. Isaac P. Trimble.—The great trouble with those who have orchards is, that they want to get two crops from the same ground, which cannot be done; certainly not if a permanent and profitable orchard is required. If we are to have apples, we must be content with apples. There are a few orchards in west Jersey where buckwheat was sown and turned under year after year, other fertilizers were applied, and these are the only orchards I know of which contrive to bear fruit. On the other hand, the ground of the great mass of orchards has borne in corn, potatoes, grass, and rye, and with the help of the curculio they are ruined.

Dr. J. E. Snodgrass.—Clover has great value, because it has the property of absorbing phosphorus from the air.

Mr. James A. Whitney.—The doctor is mistaken with regard to this alleged property of clover. Phosphorus does not exist in the air, but as phosphoric acid is drawn from the soil by the roots of plants. It occurs in the first instance in the older or granitic rocks. As the rocks become disintegrated, the phosphorus, in the

form of phosphoric acid, is liberated and passes into solution in the soil, and in this form is taken up by the plants.

Mr. Wm. Lawton.—I have heard it said that lime has been applied to land containing iron with good results.

Mr. James A. Whitney.—Lime cannot neutralize the effects of oxyd of iron in the soil, because lime and oxyd of iron are both basic in their nature. Lime could doubtless be used to advantage in soils containing the sulphate of iron, for the lime would unite with the acid of the sulphate of iron and form a sulphate of lime, and the iron would be left as a simple and harmless peroxyd.

Report on Roger's Broadcast Seeder.

Dr. J. E. Snodgrass presented the following report:

Your committee have tested "Roger's Broadcast Seeder," exhibited before the club by the agent of the patentee, Mr. C. W. Tothaker. We employed it on twenty-one feet lands. Over these it was found capable of casting the grain used (oats) with a regularity rarely attainable by hand sowing, and much more rapid, while saving much muscular exertion.

To give a rough idea of the plan of this implement and the principle of its action, we state that the grain is distributed over the field from a tin pan about a foot in diameter, over which is a little hopper, surmounted by a sack of about three pecks capacity. This pan, as it revolves back and forth from left to right, and the reverse, furnished as it is with partitions and flanges dividing it into sections, throws out the seed with a scattering motion, very much as the two human palms with fingers stretched would do if fastened together and still allowed oscillatory motion with the same facility. Motion is given to the hopper, in order to distribute the grain to the pan in the quantity per acre desired, by a piece of wood resembling a fiddlestick with a leather strap attached to either end. The strap is coiled once around a short shaft, fastened to the center of the revolving pan, and causes the desired motion in the same way that the "drill bow" of the watchmaker turns his drill. The strap, at the same time, is made to give the distributing motion to the hopper, whose "shoot" is regulated by a screw.

This novel implement promises to make seeding so much more musical, as well as more facile, than is attainable by the process of hand sowing, that it has suggested the possibility of *reversing* the fate

of that rather venerable though mythical field hand, "Poor Old Ned," because it seems to bid the farmer

Lay down the shovel and the hoe,
And take up the fiddle and the bow!

Seriously, we beg leave to report that we think the simplicity and cheapness of its construction, and its easiness of repair, in addition to the consideration of its capacity to do all that is claimed for it, stamp it a success.

J. E. SNODGRASS,
J. V. C. SMITH,
JOSEPH B. LYMAN,
Committee.

ICHNEUMON FLY.

Dr. Isaac P. Trimble, Newark, N. J., brought several wonderful specimens of the cocoons of the Ichneumon fly. This creature, he says, is appointed by God as the scourge and destruction to many of the leaf eating worms. The fly lays eggs in the body of the worm and these eggs become little cocoons on the surface of the worm's body, and turn to flies, which repeat this exercise on the bodies of other worms. This is a special arrangement in our favor and against our insect enemies. He also showed the little seventeen year locusts in the ground, sucking the little roots of grass and plants.

DEEP PLOWING.

Dr. J. F. Caldwell, Lewisburg, West Virginia.—This is proper for a deep soil. The soil of land cannot be plowed too deep, as when loose the roots of vegetables penetrate it more easily than when it is solid. The deeper it is moved, and the more it is brought up from below to the top, the better, as the properties of that part which is deepest is most inert, from its not having been operated on by the sun, air, frost, etc., as that on the top has been, and the soil which is turned under obtains rest, and becomes renovated. But the clay should never be brought up by the plow above the soil, for if this is done, it will become hard, and prevent vegetation from growing. The tops of vegetables cannot well penetrate a stratum of clay above them; but their roots will, to get to water, go through clay below them. Great advantage can be derived from breaking up a clay foundation under the soil, of several inches in depth, with a subsoil plow (say a common thin colter, with a point about two inches in width, not more), as it will enable the clay ground to receive more water and retain it longer. This is

the very best way to prevent steep land from losing its soil by washing; for if the soil is thin and the clay is hard, more of the water which falls upon it will run off and operate to carry the soil and clay with it; but the deeper the clay is loosened, more of the water which falls on it is retained and absorbed by it. When the ground is covered with grass, as it always should be when not otherwise in cultivation, the grass will protect the land from injury by water flowing over it. A soil that has a large constituent of sand, or is based on sandy ground, cannot be plowed too deep. Every kind of soil, however solid or heavy, is comparatively lighter than sand or clay; and these latter, though they may be brought by the action of the plow to the surface, will, because of their greater gravity, in process of time, fall again and get below the soil; and the cultivation of the land, frost and water will aid them in falling below it. We should be instructed by nature in this matter, and respect her arrangement of soil, clay, etc., in their order of strata, as she has done. To turn under a crop of vegetation is only to assistant her in its decomposition and conversion to soil. Of all the components of the ground, clay is the most compact, and will retain water the longest. Sand is the most porous, and is least able to retain water; soil is the most spongy.

Special Fertilizers with Wheat.

Mr. J. W. Vanderen, Niagara county, N. Y., asks the club about the use of salt, ashes, and plaster with wheat.

Mr. S. Edwards Todd.—There can be no doubt as to the use of ashes and plaster on wheat fields. Salt is still a mooted question. John Johnson has found out that salt is good for his farm; every cultivator must find that out for himself; no general rule can be given. But the management of Mr. V. is not the best. He should have put his salt, ashes and lime on grass and potatoes and kept his yard manure for wheat. Salt and ashes come a great deal nearer being a special dressing for potatoes than for wheat lands. But Mr. V. should not think of taking two wheat crops in succession from any land in Niagara county. The best wheat growers in New Jersey and Pennsylvania never attempt it. Wheat wants nitrogenous manure. You can find it in barn-yard compost and also by plowing under clover. Wheat lands should be limed, but wheat is not much of a lime consuming plant. The best system for Mr. V. and all the western New York farmers is to get their lands as rich as they can by the use of lime and ashes, and peat and salt, and then turn under

a good clover sod in August; use some fertilizers from the yard, if you have them, as direct manure for wheat.

Adjourned.

September 8, 1868.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

DO CALVES NEED WATER.

Mrs. Mary F. Trust, Atlantic City, N. J.—In my daily walk from the house to the sea, for several successive days, I observed a number of calves in an apple orchard, always laying together in the same place. As there was no water in the orchard, I inquired of the man in charge of the farm if these calves confined were not suffering for want of water. He replied that they would grow much faster and better without until winter sets in; that the dew was sufficient; if allowed water they would feed less. The owner of the farm, a widow lady, thinks differently; consequently an argument occurred, and I said that I would write to the Farmers' Club for their opinion.

Mr. A. J. Caywood.—When there is a plenty of good grass, young, and even old cattle, will do well without water. I have kept quite a number on a mountain farm for months where there was no water, and they did well. In thirty pounds of green forage there are twenty pounds of water.

Dr. J. E. Snodgrass.—When prize fighters are in training they are deprived wholly of whiskey, and to a great extent of water. In this respect we are taught a lesson, and we ought to be willing to receive it. I drink very little water myself, and then only at meals. Young stock do not need water, nor in particular do sheep; and goats seldom or never drink. One reason why cattle drink water is because they have so much salt. In like manner men drink whiskey and use tobacco, and overload themselves with poison, then they want water.

Mr. N. C. Meeker.—Some years ago Sylvester Graham taught that we would be better off without water, also that we should use no meat, butter, salt, tea, coffee, or spices of any kind. Now, if he was correct as regards man, and our friends are correct regarding cattle, there must have been some mistake in making water at all.

Dr. J. V. C. Smith.—I knew Dr. Graham personally; he conscientiously lived up to his theory, and he should have lived long, but he died comparatively young. Paracelsus, that great alchemist who professed to be able to perform the most wonderful cures without

regard to known methods, and princpially by a wonderful elixir of life, died himself before he was fifty, with a bottle of his elixir in his pocket. Now, as regards cattle thriving any great length of time without water it is impossible, because they are not so constructed as to be able to do so. There are two, and only two animals which form an exception; these are the camel and the blood leech. I have before described to this club the construction of a camel's stomach with its pouches for holding water, and they carry enough in these to last sixteen days, as I can testify, having myself traveled in a caravan across the Arabian deserts this length of time. When the medical leech is put on he fills a series of pockets with blood, which from time to time enters the stomach the same as water into the camel's, and he will suck in blood enough to sustain life two years. After that he wants more blood. But the medical attendant can strip it out, when he is ready for another meal.

Mr. A. S. Fuller.—I keep my horses in good order on water, which I give five times a day, and I feed less grain, and have fatter animals than my neighbors.

Dr. Isaac P. Trimble.—The object with good farmers is to have clean, cold water in every pasture if possible. I have never tried whether cattle can live without water, and I never shall. This is a subject not worthy of our attention, except to urge the importance of having a plenty of water.

Mr. Ferguson.—While cattle are young, and with sheep, I have found that it is of importance to have water in the pasture in the early part of the summer. Much depends upon the food of the animal. Juicy roots, as the beet and the carrot, will afford so much water that no supply is required. I have found that calves in a dry pasture often grow faster than those who get all the water they want.

Mr. P. T. Quinn.—My experience is that cattle require water often. As a member of this club I must protest against the cruelty of recommending the contrary. It is true that in feeding roots cattle will not drink often, for the reason that they get much in their feed. In training horses, muscle is developed more if water is limited; but to produce flesh or fat, which is a main point in the care of animals, water is an absolute necessity.

Hexamer's Prong Hoe.

Mr. C. H. Murray, Clay City, Ill., testifies to the excellence of the implement as follows: I wish you to say an additional good word for

Hexamer's pronged hoe. It fills a want among agricultural implements before unsurpassed. For loosening up the dirt about grape vines and fruit trees, and for digging all kinds of root crops, it has no superior. Any one that works much in a garden should not be without one. Let any one invest money in that hoe, and in a short time they will wonder how they could ever get along without it.

Mr. P. T. Quinn.—I have used this hoe, and on light land I like it very much. It can be used with six, four or two tines, according to the character of the work required of it. The tines can be taken out and keyed in as easily as a scythe is taken from the snath, and the temper and finish of the tool is such that it lasts a long time. It answers also for a potato digger, which it resembles in appearance.

THE BLACK CURRANT.

Mr. George Partise, Ferguson's Corners, Yates county, N. Y.—I would like to know if the black or English currant can be cultivated profitably. I understand it is made into wine in France.

Mr. A. S. Fuller.—Yes, the black currant is a profitable fruit. It will grow on land too sandy for the red variety, as on Long Island and the pine lands of New Jersey. It is rather slower than the others, and comes in bearing on the third or fourth year, while the red comes into fruit the second year, and produces more. But the price of the black currant is about double that of the common red. For five or six years the culture of the black has been far more prevalent.

Much of the port wine is made of the black currant, but I do not call anything wine unless made of the pure juice of the grape. I used to detest the odor of this currant; nothing was so disgusting; but after handling it for a great length of time, I like it and prefer the fruit to any other. This is a taste to be acquired. We have a great variety of native currants, particularly between the Mississippi and the Pacific, which should be cultivated and become better known. I have been experimenting many years and hope to get some valuable seedlings. Instead of taking this course, our nurserymen import every strange and unfit thing from Europe, as though coming thence it must be good.

Mr. P. T. Quinn.—The black currant does not bear as well as the red variety.

The Walter Grape.

A. J. Caywood, of Poughkeepsie, came before the club with a single, large, fine, ripe, fragrant cluster of this new variety. It was passed from one seat to another, but nobody could taste it. He asked the Chair to give him a committee to go up and visit his vineyard and report on what they could see and taste.

Mr. N. C. Meeker.— I have nothing to say against this grape; indeed, what I have seen of it, I think it an acquisition. But exhibitors do themselves injustice by having such small shows for specimens. It looks as though their fruit was very scarce. It seems to me that the best way to prove that a new fruit is valuable is to grow it for market, and then let the public decide upon its merits. It is taking a fine sight to present a fruit that is only to be smelled.

Mr. A. J. Caywood.— It takes a long time to propagate a new grape. There are fifty clusters on the vine, and I hesitated a long time this morning before I picked this cluster, because I intend to take the whole to Cincinnati to compete for the prize for the best seedling; also, to other places. I never saw so much mildew on my place among the grapes before, but the Walter is unaffected.

Mr. E. Williams, Montclair, N. J.—On the Hudson river, at Newburgh, is a fruit garden owned by a gentleman eminently skilled in all kinds of fruit. This grape should have been tried on these grounds, for, with the good opinion of Charles Downing, the grape would have a reputation worth something. Nor is it to be found elsewhere. What do we know of its general adaptability, what will the committee know of its power to withstand the various and trying climates of the interior of central and southern Ohio, Iowa, Missouri, and Kansas?

Mr. A. J. Caywood said he did not ask any favors of the committee; he would have them to condemn or to praise just as their judgment should dictate. Nor would the public buy if it was not good. It must stand on its merits. Mr. Downing knew the reason why he did not have it on his grounds, and others knew why they did not have it. Mr. Caywood did not say, but it was inferred, that the reason why it was kept so close was to prevent nurserymen from getting hold of it and propagating it.

Prize Tomatoes.

A plate of uncommonly large, smooth, and well-shaped tomatoes, from a lot exhibited at the New Haven fair, were brought before the

club by Mr. J. B. Lyman, who said they were from the garden of Mr. William Parmelee; and in conversation with him he gathered the following account of his method of improving this vegetable:

Mr. Parmelee lives two miles from the center of the city of New Haven, on a tract that was originally a very hungry land, so poor that the former owner had starved on twenty acres of it. Mr. P.'s tract is seventeen acres, and by deep tillage and generous manuring he has brought it to a high condition. He has had the greater part of it subsoiled two spades deep. It costs him $100 per acre, but it pays. The fields thus subsoiled give him no trouble from drought, while the other parts of the tract not thus treated burn up in July and August, unless the season is uncommonly wet. The tomatoes shown were produced by crossing the small round upon the large red. The varieties were set out side by side, and thus a tomato uniting the excellences of each is the result. He does not manure heavily for tomatoes, and finds a sandy soil best for them. He fertilizes just around the plant to give rapid growth early in the season; but in August he prefers to starve the roots more and earlier fruit is obtained. He has been for several years engaged in bringing the tomato to the perfection here seen. He uses no support or trellis for the vines and needs none. He germinates the seed in a hot bed by the use of horse manure, and transplants to cold frames where they stand five or six inches apart and grow till warm weather. Then he sets in the field three and a half, or four inches apart each way. For seed, he selects the tomatoes that are desirable for shape and size, and have the most solid flesh. Nearly all his fruit is of the form and size of the specimen exhibited, nine inches in circumference, regular in shape, without seams or partitions, and firm and solid when opened. Some larger tomatoes were on exhibition but none that were in all respects so fine.

Mr. P. T. Quinn.—I have raised some years as many as 10,000 baskets of tomatoes. These on display are certainly very fine. The mode of culture adopted by Mr. Parmelee is the sound method, and differs very little from that of other successful cultivators. It is an excellent sign in a tomato to ripen close up to the stem; such are never hollow. It does a tomato good to transplant it. Mr. P. sets his nearer together than most farmers. I generally place mine four feet apart in the rows, which are of five feet interval.

Mr. Henry Hollister, Mount Lebanon, Columbia county, N. Y.—It is almost amusing to see the varied experience in tomato growing, frequently alike, yet much that is contradictory. Our tomatoes were

sown in the middle of March, in boxes, in the shop. By 1st April, when sowing our hot bed, they were four inches high; we transplanted them into a hot bed about the 4th of April, one inch apart. They were set in turf land, a light calcareous loam. The varieties were the early smooth, Cedar Hill, Keyes' Prolific, and Tilden. Of these the Tilden was the earliest, but the seed was of my own selecting. The other three commenced ripening together; the seed I obtained of a friend. The early smooth is like a large apple, smooth, dark, greenish red, heavy, and abundant. Cedar Hill is not free entirely from roughness, larger than the early smooth by one-third; a handsome bright red, rather tender, but full of meat; its best characteristic is to ripen up quick, not being thoroughly ripe on one side, and green on the other, but all ripe and red. Keyes' prolific is a good solid tomato; the largest ripen first, in size like medium apples, bears well. I have tried the Tilden four years; have increased its earliness seven days in that time. One thing I noticed that I have not seen mentioned by correspondents; the Tilden tomato has two distinct shades of color; one is bright red, bordering on the yellow, or, at least, not so deep and handsome as the Cedar Hill; the other is a deep flesh color, like the old fashioned beefsteak tomato. The first is solid, and tough to the feel; the last is soft, even before fully ripe, not so heavy; still they have the same shape, and ripen alike. For the last five years I have tried to get the earliest tomatoes that close attention, skill, and good cultivation would produce, and here, on the side of Mount Lebanon, in Columbia county, 1,200 feet above tide water level, in latitude forty-two degrees, we seldom fail to obtain ripe tomatoes by the 1st of August, by simple out door culture.

Protection for the Originators of New Fruits.

Mr. Jacob Moore, Rochester, N. Y.—The originators of fruits are not protected by the government, and consequently they are without adequate remuneration. Are they not as much entitled to protection as inventors and authors? Originators of fruits should be protected for three reasons. First, because the present system of disseminating new fruits deprives the originator of a fair opportunity of profiting by the work of his hands, and is, therefore, in effect, a transgression of the eighth commandment, namely: "Thou shalt not steal." Protection would stimulate the production of improved varieties, and bring the fruits of the country to the highest degree of excellence. The production of good fruit conduces to the health, happiness,

morality and profit of all classes of mankind. A popular fallacy is the belief that the originator of a valuable new fruit can acquire a fortune. Facts prove the contrary. Did the originator of the Concord grape, the most widely cultivated variety in America, profit by its production? It is generally thought he did not. A certain well known hybridist is reputed to be a man of very moderate means. I know it is rumored that a certain grape grower has acquired a large fortune in the sales of a variety produced by him; but I have good authority for believing otherwise. Did the originator of the Wilson strawberry profit by it? Certainly not. In fact I have yet to learn of the originator of any fruit profiting largely by it. The reason is the competition of other propagators. For a new fruit, however valuable, there is generally little demand, and the originator is obliged to rely on a demand for compensation. The cost of introduction is borne by him, while others oftentimes reap the profits, on account of having better facilities for selling and propagating. In any case the originator can only expect adequate compensation during the first two or three years of dissemination before the public can fairly test the variety, thus affording him no opportunity for remuneration proportionate to its value or the popularity it may afterward attain. The protection of the government is necessary to correct these evils. All new fruits could be tested at Washington, not merely to determine their value, for this oftentimes depends upon soil, location, etc., but to prevent the dissemination of the same variety under different names. Patents could be given for improved varieties, but would require to be different from that for a mechanical device, as the latter would forbid purchasers to propagate the varieties on their own grounds for their own use, without payment therefor. Such a patent would hardly be desirable, as it might restrict the sale of a new fruit, and would not generally be regarded. The requisite patent would be one giving the originator of any fruit propagated by graft, cutting, or runner, the sole right of its propagation for sale. It must be borne in mind that it is not the public generally that deprive the latter of custom, but the nurserymen. Such a patent would prevent them from so doing; they could not advertise the variety without purchasing the right to do so, and if they attempted a nefarious business, they would constantly risk detection. In case of anything propagated by seed or tuber, as the potato or grains, for instance, evidently protection would not be available. The offer of large premiums by the general government might, however,

induce many to undertake the production of improved varieties of such things. Their production certainly ought not to be overlooked. The originator of the English Fluke potato benefited England and other countries to an incalculable amount, and died in poverty, having received no remuneration, simply for the want of legislation. That improved varieties of fruits are desirable few will deny. If the Baldwin, a second rate apple, and the tree not hardy in many sections, is the best apple for general culture, and the Concord, a second rate grape, although a hardy vine, is the best grape for general culture, as a certain fruit committee have decided, there is certainly room for improvement. There are almost innumerable varieties, it is true; but few indeed that combine in the requisite degree the principal qualities of vigor, hardiness, productiveness, and excellence. Nature is not profuse of prodigies. The field for improvement in horticulture is quite as wide as that of invention; besides varieties wear out like other things, and new ones require to be raised from seed. Civilized nations have accorded protection to inventors and authors, and great good has resulted from the stimulus of such measures.

Value of Broom Corn Seed for Food.

Mr. L. Smith, Cadiz, Ohio, inquires as above; also, the value in comparison with oats.

Mr. N. C. Meeker.—Chickens eat broom corn seed, and horses are said to thrive on it, but it seems rather too woody. Those who have experimented will please let us know more. As a general thing, an article so well known as broom corn seed has no qualities which are not generally known.

Sykes' Reversible Plow.

This invention has just been perfected, and a working specimen was brought before the club by the inventor. The mould board reverses by swinging up instead of down, and the weight is so balanced that it moves with great ease. works on level land as well as on a side hill, and by using it the dead furrow or sink in the middle of each land is prevented. This has a cast iron plow beam, and is in all respects made strong and durable. The inventor is making them at Suffield, Connecticut.

Adjourned.

September 15, 1868.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

INSECTS — PREMATURE BUDS.

Mr. J. W. Staples, Newburgh, Orange county, N. Y.— Why do the leaves of so many apple trees turn brown and fall this year? Will this injure the fruit? I notice, too, that dormant buds of currants and the Antwerp raspberries are bursting. Can such buds perfect fruit next year? Is there any remedy for the white grub?

The Chair.— Of course, when the leaves of fruit trees or vines perish the fruit also must perish.

Dr. Trimble.— I suppose this condition is owing to the weather, that is, the long, heavy rains. Still, this is only a confession of our ignorance. Plant lice often cause the leaves to fall, but I have not noticed their presence or that of any other kind of insects to produce this result. As to the grub, little can be said, because I do not know what kind is referred to. If it is the white grub with black head, there is no known remedy but to summer fallow. Some recommend salt, but they will live and perfect thousands in salt.

Mr. Quinn.— When buds start in the fall they cannot bear fruit the next year, but there are almost always reserved buds from which a partial crop may be expected.

Inquiries were made about the ravages of catterpillars, and Dr. Trimble said there are a great many kinds; those here this year are not likely to stay more than a year or so, when they will be followed by other kinds which may be less destructive.

The special subject for the day being manures, the following paper was read by Mr. James A. Whitney, of the *American Artisan*.

ARTIFICIAL FERTILIZERS AND THEIR USES.

The term artificial fertilizers, as commonly employed, is sufficiently comprehensive to embrace nearly all fertilizing materials other than those which, like barn-yard manure, have been in immemorial use, and such may be divided into two great classes; first, those which may be properly called manures, inasmuch as they yield the elements which enter into the composition of the plants; and second, those which increase the productiveness of the soil by chemical or mechanical action. The first of these classes may be again divided into two others, mineral and organic manures, and these latter in their turn

may be the most conveniently considered under the two heads of those which, for the most part, yield ammonia, and those of iron, silica, phosphoric acid, sulphuric acid, chlorine, and more rarely manganese, iodine and fluorine. All of these are generally found in the soil in sufficient quantities, except potash and phosphoric acid. In addition to these the soil must have ammonia, which is most frequently deficient, so that, as a general rule, effectual manuring means simply this, the plentiful supply of potash, phosphoric acid and ammonia to the soil; and any specimen of the class of fertilizers of which we are now speaking is valuable just in the proportion in which it contains these substances in a soluble form. We say in a soluble form; for each and every one of the constituents we have mentioned must enter the roots of the plants dissolved in water, and that, too, in such a minute state of subdivision that for every grain of mineral matter deposited in which, owe their value chiefly to the phosphoric acid contained in them; but it must be borne in mind that it is very difficult to draw the exact line between these two last mentioned varieties of manures, inasmuch as many of those which contain the largest amount of ammonia possess also a considerable percentage of phosphoric acid. There are about a dozen mineral substances which enter into the composition of vegetables, and which, in some form or other, must exist in the soil to make it productive for all kinds of plants. These are potash, soda, lime, magnesia, peroxyd of iron, silicic acid, phosphoric acid, sulphuric acid, chlorine, and, in less numerous instances, iodone, fluorine and manganese. These all enter the root spongioles in solution in water, and so dilute is this solution, that in order to enable the aggregate of the mineral constituents of a plant to enter its organism, not less than two thousand times its weight of water must pass into the plant and be exhaled from its leaves; and hence we see that it is not enough in estimating the value of a fertilizer to know merely the quantity of enriching material that it contains, but we must be aware as well of the comparative facility with which these materials may be dissolved, and thus brought into proper condition to be absorbed by the roots. It should be mentioned in this connection that although more than one-half of the substance of all vegetable organizations consists of carbon, which in the form of carbonic acid enters the plant for the most part through the leaves, the carbonic acid generated from manure applied to the soil acts only a secondary part in improving the land itself, which it

may do by assisting the water to better dissolve the mineral constituents, of which we will speak further hereafter. To consider in succession the three subdivisions of that class of fertilizers which furnish plant food, we may speak first of those which are characterized by their comparative abundance of ammonia, a substance that in solution is known by the common name of hartshorn, which was given to it because it was first obtained by distilling the horns of harts or deer. It is obtained most abundantly from the decomposition of animal matter; it is alkaline in its nature, and consequently combines with acids to form salts, and has a strong affinity for water, the latter, at a temperature of sixty degrees, being capable of absorbing ninety times its volume of ammoniacal gas. The ammonia in a state of solution, being absorbed by the roots, is carried upward and decomposed in the interior of the plant, and contributes to the formation of the albuminous matter in the woody portions, and in some plants, as, for instance, in peas and other leguminous ones very materially to the constituents of the seeds. Ammonia may exist in the soil in solution as just mentioned, or it may be in combination with various acids, and consequently in an inert condition, or it may be absorbed by humus or vegetable matter in the soil, which has a strong affinity for it. These conditions should be kept in mind as of great importance, not only with regard to the branch of the subject of which we are now speaking, but with reference to the action of lime, potash and other strong alkaline agents which we shall have occasion to mention further on. For practical purposes artificial ammoniacal manures may be classed as guano, too well known to require minute description here, and divided by agriculturists into ammoniated and phosphatic guano, according as the ammonia or phosphoric acid preponderates in its composition. The materials resulting from the composting of animal matter with substances capable of absorbing or neutralizing their ammonia, as in the so called poudrettes, and the products obtained by the combination of other substances with the ammoniacal liquors produced in various manufacturing processes, among which may be named the chemical compound sulphate of ammonia, which has been stated to have been employed in England with considerable success. The value of each and all of these, from the standpoint from which we are now looking, must be estimated according to their relative proportions of ammonia and the readiness with which the same may be brought into a state of solution in the soil. Guano has been used as a fertilizer in Peru from the earliest

periods of which the Aztec traditions tell, but was first introduced into England in 1840, and into this country about the same time, or a little later; it owes its highly concentrated manurial virtues to the highly organized nature of the fish which constitute the food of sea birds, and the rapidity of action is due to the great solubility of its constituents in water. The quality even of pure guano varies greatly according to the region from which it is brought; that known as Peruvian, which comes from a dry locality, containing as much as eighteen per cent of ammonia, while that from localities subject to almost perpetual rain, and which has had a considerable proportion of its most valuable constituents washed away, has its worth diminished in proportion. Guanos, especially those containing the most ammonia, exert their most beneficial action in hastening the growth of the young plant and in encouraging a great expanse of foliage and growth of stem, which, by adding to the power of the plant to absorb carbonic acid from the air, quickens and increases the development of the plant, so that, as in the case of turnips, the period during which it is liable to be attacked by insects is shortened, and more than this, the time of ripening is often materially advanced; a matter of importance in many portions of our own country, where the crops are liable to be nipped by early frosts. It is necessary, furthermore, in order to secure the most efficacious results from the employment of guano, that it should be applied at those periods which may be characterized as tolerably moist and cool, and upon soils somewhat heavy and capable of retaining moisture; for, in this case, the ammonia dissolved in water will be retained in the soil until absorbed by the roots of the plants; while on the other hand, if the soil be loose and porous, the soluble parts of the fertilizer may be washed downward by rains out of reach of the plants, or if the weather be dry and hot and the quantities of humus in the soil be limited a portion of the ammonia may be volatilized and dissipated in the air. We have seen that guano has an especial effect upon plants in the early stage of the growth, but the seeds of all vegetation contain a much larger proportion of phosphoric acid than the leaves and the stems. A large part of this may be derived from the guano, particularly when phosphatic guano is employed; but it is found good in practice to assist the ripening of the plants, especially of leguminous ones, by an application of more decidedly phosphatic manure, as will more fully appear when we come to speak of superphosphates and the like.

Furthermore, as the constituents of guano are very soluble, and act rapidly upon vegetation, it follows that their action is limited in duration, and for this reason it is best to combine the use of guano with barn-yard manure; one-half the quantity of the latter combined with an equivalent of guano being but a trifle less efficient in immediate effect than if guano alone were used, and at the same time continuing to show results upon the crops for a longer period. Next in importance to the guano, and much more artificial in their nature, are the so-called poudrettes, made by combining the night-soil of cities with materials capable of absorbing or neutralizing the ammonia in or resulting therefrom. Like guano, these compounds vary greatly in value, the difference arising from the greater or less degree to which their ammonia has been fixed. They may be considered as inferior to guano in the proportion of phosphatic matter, and may be employed in the same manner as the ammoniacal guano, care being taken, as in the use of the latter, to apply the poudrette either just before or during the rain, in order that its virtues may be carried into the earth, and not dissipated in the air. With regard to the adulteration of both of these varieties of fertilizers, it may be said that with guano the sophisticated article is so often made to resemble the pure substance that an inexperienced person cannot be expected to know the difference, and the fraud can only be detected by an analysis by a competent chemist. With poudrette the very process of manufacture affords opportunities for adulteration with infertilizing materials, and the test just named is the only one that can be relied upon as a true index of its value. In addition to the two varieties of artificial ammoniated fertilizers which we have just considered, and belonging to the same class therewith, may be named the products resulting from the composting with other materials of the blood from slaughter houses, the refuse hair from tanneries, and in general any animal or nitrogenized substances; but the most notable example of this class remaining for consideration is probably the so-called fish guano, which is simply the refuse or pomace left after the expression of oil from the fish called moss bunkers, on the Atlantic coast. The tissues of fish are believed to contain a larger proportion of phosphorus than other flesh; and the presence of the fish bones in the material just indicated, add an increased proportion of phosphoric acid, which, with the ammonia resulting from the decomposition of the tissues, must in the very nature of things constitute a very valuable manure, provided it is put into the market without adulteration. It is not,

however, as valuable as a good grade of guano. It may be used in much the same manner as guano, except that being less soluble in its nature, it will not be carried readily into the ground by rain or moisture, and should consequently be well incorporated into the ground; for the same reason it may be found somewhat slower in its action than guano, and proportionately more lasting in its effects. It may be mentioned in this connection, that in England fish have been employed as manure in considerable quantities. The kind most extensively employed is the sprat, which is caught in immense quantities on the coast of Norfolk, and is principally applied in the culture of turnips. A chemical analysis of this fish gives their composition as sixty-four and six-tenths per cent of water, thirty-three and three-tenths per cent of organic or nitrogenized matter capable of yielding ammonia, and two and one-tenth per cent of potash and other mineral salts. We may now turn to the consideration of the phosphatic fertilizers, among which guano, already discussed, may be said to occupy a middle rank, its phosphoric acid, as has been mentioned, in some cases being in excess of its ammonia; but this substance needs no further mention here, other than that its phosphoric acid, in proportion to its quantity, acts in the same manner as the so-called phosphates and superphosphates, of which we are about to treat. Phosphorus, which constitutes the base of the phosphoric acid, so essential to the growth of vegetation, is one of the elementary substances, and occurs primarily in the granite rocks. As the rocks are worn and disintegrated in the formation of soil, the phosphorus, in combination with oxygen and constituting the phosphoric acid just mentioned, is liberated and, in solution in water, is carried into the structure of plants, entering more particularly into the composition of the seeds, which frequently contain from thirty to thirty-five per cent. When the plants are eaten by animals the phosphoric acid is deposited, to a slight extent, in their flesh, but in large quantities in their bones and cartilaginous structure, where it exists in combination with lime as the phosphate of lime. For all practical purposes, whether manurial or other, for which this substance is employed in arts, and in industries, it is obtained from such animal organisms. The latter are often thousands of years old, as in the case of the fossil remains found in the crag formation and in the green sand-stone in the south of England and in many parts of our own country. These consist in the remains of bones of sharks and whales and great lizards, which are

fractured and worn by rolling under the waves of seas that once swelled where the dry land now lies. Phosphoric acid exists in abundance in these deposits, but in various degrees of solubility; for we find that those in the so-called crag formation are very hard, so that they must be crushed by strong machinery made especially for the purpose, and then treated with sulphuric acid before they are fit for use. On the other hand, the fossils which are found, but in less abundance, in the green sand, may be made sufficiently fine by common machinery, and need no chemical treatment to render the phosphates soluble in the soil. As a special manure these last named fossils are said to be particularly adapted to the culture of hops; and one parish in England is noted for its excellent growth of this crop, which is ascribed to the presence of this kind of organic remains in the soil; and a fair inference from this would be, that any preparation of phosphate of lime would be found advantageous in the culture of the hops, which it may be mentioned is now treated principally with barn-yard manure, and in some cases with lime, the use of the latter except in alluvial or upon very moist, clay soil, in many cases doing much more harm than good. The fossil phosphates, although capable, as just explained, of very efficient application, constitute only a small portion of the phosphates employed in agriculture, and may, upon the whole, be considered inferior in value to that existing in the common form of bones. It is now upwards of half a century since bones, broken into pieces with hammers, were first applied as manure in the west of England, great quantities in this form being required for a comparatively small area, but showing beneficial results many years after their application; but it was soon found more advantageous to grind them to a coarse powder in mills, for in this case a smaller quantity would, as far as immediate results are concerned, yield as good results, the usual plan being to apply from sixteen to twenty bushels per acre for turnips, for which the use of bones has been found beneficial in the extreme. This method of powdering the bones continued in universal use until Liebig's discovery of superphosphate, which, as being the most approved vehicle for supplying phosphoric acid to the soil, merits an extended explanation of its composition, manufacture and uses. We have already seen that the phosphoric acid from the plants eaten by the animals is for the most part stored up in the bones of the latter, where, in combination with lime, it forms the principal part of their inorganic or earthy portion. The phosphoric acid and lime together consti-

tute phosphate of lime, which consists of definite proportions of the acid and lime. In this form the acid is moderately soluble, and may be absorbed by the roots of plants with considerable readiness. It is found, however, that if we dissolve the bones in sulphuric acid or oil of vitriol, that the sulphuric acid unites with two-thirds of the lime, driving out the phosphoric acid therefrom into the other third of the lime, which, with this triple portion of the phosphoric acid, constitutes superphosphates. By this means the whole of the phosphoric acid is made immediately soluble and consequently acts very quickly upon the plants. Its effects are, indeed, so rapid that in practice it is better not to convert the bones wholly into superphosphate, as otherwise the effect would be too powerful at the beginning of the season when ammonia is most required, but would be almost spent at the end, when the formation or ripening of the seed demands the greatest supply of phosphoric acid. About one pound of sulphuric acid to two pounds of bones will generally be found the most proper proportions in making superphosphate, but the quantity of sulphuric acid may be diminished or increased according as the fertilizer is desired to exert a more or less rapid effect upon the plant. The best way for the farmer to obtain superphosphate is to make it himself, inasmuch as the process is simple, and requires but little skill, and when carried out under his own eye yields a manure of the value of which he may be sure; while, on the other hand, there is no guarantee but the statement of the vender that the purchased article has not been adulterated. Superphosphate has, indeed, like bone dust, so-called, guano and other artificial fertilizers, been notoriously a subject of common adulteration with comparatively worthless substances, which even a chemical analysis, unless conducted with the greatest care, will not always fully expose; for a manure may, by analysis, indicate a large percentage of phosphate, and yet this latter may be in a condition in which the plant roots are unable to lay hold of it. It has sometimes happened that so termed phosphate has been put in the market which did not contain a particle of soluble phosphoric acid. As just explained, the superphosphate is very soluble, and consequently acts with such rapidity that it is expended the first season; hence when it is desired to secure more permanent effects, bone meal should be used instead, as being less soluble and of course less quickly taken up by the plants. With regard to the quantity to be used per acre, no general rule can be laid down for this; to secure the best

results, it must vary with the character of the soil, and the kind of crop, and a consideration of all these would extend this paper far beyond due limits. To turn now to the remaining subdivision of our subject, we may speak briefly of the mineral fertilizers; and although this may be said to include many different substances which, like nitrate of soda and sulphate of magnesia, have been used on a small or moderate scale with good results, and others more widely used, like gypsum and the like, it must here suffice to consider only the two most important substances belonging to the class: Lime and potash. The first of these, in the great majority of cases, can scarcely be termed a manure, inasmuch as most plants, especially the cereals, contain but a comparatively small portion of lime, and the great majority of soils possess a sufficient proportion of this mineral to supply the wants of the crops grown upon them. There are, however, a few plants which require lime in comparatively great proportions in the soil, as for instance in the leguminous plants, peas, beans, etc. Lime in these often constituting thirty per cent of their ash, it may sometimes occur that these crops are planted on soils which do not contain the requisite quantity of lime; and the latter when applied thereto might be classed as a manure, inasmuch as in such instances it would contribute directly to the sustenance of the plant. In these cases the lime may be applied in the simple state of the slacked carbonate, or, what is better, in the form of gypsum, which is supposed to possess, in addition to its power of contributing lime to the plant, the valuable property of absorbing or fixing ammonia, which accounts for its great efficiency when applied as a top dressing for clover. Aside from its exceptional action in thus aiding the nutrition of vegetation, the action of lime in ameliorating the condition of the soil is both chemical and mechanical; chemical in breaking down and reducing to other forms and combinations the elements of the soil, and mechanical in changing their texture. Lime has been used in English husbandry for more than a hundred years, and in some parts of Great Britain it has been the practice to lime the land once in twelve years, at the rate of from 120 to 200 bushels per acre; but it is found much better to apply smaller quantities at shorter intervals, and in this country, as in England, its use will be found most profitable upon wet and boggy land, upon that recently drained, and upon the low alluvial flats by streams and rivers. The reason of its great efficiency in these cases may be thus explained. All soils of the character indicated contain

a large quantity of decaying organic matter, the decomposition of which produces various acids which are hurtful to vegetation. Lime neutralizes these acids, and consequently sweetens and warms the ground, and thus fits it for the better growth of plants; and more than this, these acids very frequently exist in combination with ammonia, and lime, being the stronger alkali, expels the ammonia, which, being held in solution in the moist soil, is more readily absorbed by the plant roots. Lime also acts upon the organic constituents of the soil, as is seen more especially in peat soils, in which the vegetable remains frequently exist to an excessive and injurious degree, the lime in this manure changing the structure of the soil and rendering it more capable of retaining moisture and heat, and consequently greatly facilitating the growth and development of plants. In closing our remarks on this fertilizing agent, we would urge the farmer to always bear in mind the property of lime, hereinbefore adverted to, of displacing ammonia from its combinations; for it frequently happens that the husbandman, knowing that barn-yard manure and lime are both good, thinks to make them both better by mixing them, and is much surprised to find the ammonia driven off, the manure spoiled, and the lime no better. In such a case the lime simply displaces from its combinations the ammonia, which then passes into the air in a gaseous form and is lost. A stronger appreciation of simple scientific truths like these would often lead to great economy, and to profitable results in the manifold processes involved in properly tilling and enriching the ground. Of potash, the last fertilizer of which we propose to treat in this paper, we make but brief remark, although it constitutes one of the most essential constituents of a fertile soil, and one of the most important of all the fertilizing agents within reach of the agriculturist. In many plants it constitutes more than one-half of their ash, and in most at least one-third. In neutralizing acids in the soil and in the liberation of ammonia, it acts in the same manner as lime; but when it is desired to simply effect these last mentioned objects, the latter should be used as being cheaper, and potash, generally available in the form of ashes, should be applied as a manure, using the word in its strictest sense, to indicate a substance that contributes directly to building up the structure of the plants. But considerable care should be exercised in the use of ashes; and they should never, as is the practice with some in manuring corn in the hill, be mixed with guano, or the refuse of the hen-roost, inasmuch as the first rain that dissolves them will cause the potash to displace the ammonia, in the

same manner that lime displaces it from barn-yard manure and similar manures, as we have just mentioned; and although the potash of the ashes and the phosphoric acid of the guano or the like, would be left to benefit the plant, the ammonia would be dissipated and lost, and the value of the fertilizer depreciated. Analogous to potash in its action is soda, which, however, with a few exceptions to the rule, enters but slightly into the composition of plants, and may generally be replaced to a great extent by potash. Turnips and mangold-wurtzel, however, require a comparatively large amount of soda, the ash of the former containing upwards of twenty-eight per cent, and of the latter a nearly equal amount. This may be most conveniently applied to the soil when required in the form of common salt. We have thus treated in a general manner of "Artificial Fertilizers and their Uses;" but the limits prescribed for a paper of this kind have prevented us from touching upon many things, a knowledge of which is essential to a full understanding of the subject or a just recognition of its importance. For instance, the changes resulting in the mechanical structure of a soil from drainage, the relative capacity of the same for the retention of moisture, and even its color, as enabling it to absorb and retain heat to a greater or less degree, all affect to the same extent the value and action of manurial agents when applied thereto; yet each one of these would require as much space for full consideration as has been allotted to this essay. There is, indeed, no limit to the subject, and there is no subject of more real interest to the student of science or the searcher into the mysteries of nature's ways. We know, of course, that there is little romance in this topic of which we have tried to treat. The most active imagination can scarcely detect one trace of poetry in a pile of hen roost refuse, and æsthetic taste can have but little exercise in contemplation of a barrel of guano. No halo of glory clothes with lambent light a cart load of powdered bones, and no pathos may be evolved from a sack of crushed and decaying fish. But yet, when we see this foul offal sink into the soil, and, under the action of the rain and the heat and the light from heaven, slowly separate into elements that pass into the thread-like rootlets, and into the tremulous leaves, so that from them, atom by atom are built up the blades of grass that give nourishment to the beasts of the field, and the bearded grain that makes bread for the sons and daughters of earth, and the tall trees whose fuel yields light and warmth to hearth stones of happy homes, we may well ponder in amazement at the transformation, and believe it to be but a new illustration of the moral hidden in the old

heathen legend, of the phœnix that rose, radiant and bright from the dark ashes of its funeral pile, and another proof of the truth of the saying, that we may find sermons in the commonest objects before us, and good in everything.

Dr. J. V. C. Smith.—Mr. Chairman: I rise to express my gratitude to the author of this paper. I have followed him through his able and exhaustive account of the chemistry of manures, and I know he has made a valuable contribution to the science of agriculture. Few that have not tried it are aware of the time and study required to prepare such a paper, and I move the club that we tender Mr. Whitney our thanks, and request of the author a copy of his essay for publication in the annual report of the Society.

The motion was seconded in some appreciative remarks from Mr. P. T. Quinn, and the motion passed by a unanimous vote.

The New Fabric Plant — The Ramie.

Mr. Gregory stated that having lived in the south he had learned something of this prospective new staple. It is a native of the Island of Java in the East Indies, and has been cultivated since the war in the southern parts of the cotton States. First it was brought to Cuba, then to Mexico, then to Louisiana, where it is now grown in large fields. It is similar to the large stinging nettle, and resembles the hydranga, without the flower. Planted like corn it fills the ground with roots, which may be taken for layers; it suckers much, and it is thought it may be propagated from eyes. The yield is four times as much as cotton. The whole stalk is used, and the quality is equal in its fabric to Sea Island cotton, which it is alleged it will supersede.

Grindstone for Mowing Machines.

Mr. D. W. Ayres, Chicago, Ill., showed a small emery wheel of conical shape. This is made to revolve rapidly by proper gear, and is held on the bend of the teeth of the cutter bar. They can thus be sharpened in the field without removing a bolt.

Goodwin's Strawberry Trimmer.

Mr. W. C. Goodwin, Hampden, Conn., showed a cultivator with spur and wheel attached so as to cut strawberry runners, and at the same time clear out the weeds between the rows. It was referred to a committee who will make trial of it at the New Jersey State fair, on the 29th inst. Its retail price is $10.

PATENT CORKS FOR HORSE SHOES,

Invented by Dr. Hubbard, New York city. These are for the toes and heels, are made separate, and can be put on or removed while the shoe is fast. They are fastened with screws,.and can be made for a few cents each. It is required that the shoe be made first, so as to fit the corks.

Mr. T. Cavanach.—It will be difficult to get blacksmiths to use them, and besides they cost too much.

Mr. A. S. Fuller.—The corks on common shoes last long enough, and a shoe must be taken off every four or six weeks, because the hoof grows over it. On city pavements the device might be of service, but in the country I cannot see that it will be of much value.

Mr. Allen.—I have traveled many thousand miles, and often have seen times when I would have been glad to have such corks that the team might get up hills. Those who have been obliged to start a team on the run up a rocky or slippery hill will understand this.

THE CURCULIO.

At a regular meeting of the fruit growers of Alton, Illinois, the proceedings of which are sent to us, Dr. Hull, one of the most careful cultivators in this or any other country, made the following remarks, which should be indelibly impressed upon the minds of all who have orchards. There are other insect enemies, perhaps thousands of them, which must be fought or we shall have no fruit:

I say, and have often said, that as we cultivate fruit, we also cultivate insects. I have traveled considerably this season, and find the peaches generally destroyed, also the apple, pear and plum. The curculio is sweeping everything before him; unless we wake up, he will consume our substance. Are we to sit idly by and let them breed as lice breed on children, and not raise a finger to prevent them? Nine-tenths of the horticulturists have not energy enough to fight them; we must all wake up, or they will consume us. If we all go to wor', we can keep them under, but for one man to do it, surrounded by neighbors who will not fight them, is of no use. When the thermometer is at seventy they will fly in on him, and it is impossible to catch them. I once caught sixty and painted them, and carried them to a neighbor's. I caught many of them again on my own place, showing that they will fly. We must look this matter square in the face; we can't dodge it if we would. It has resolved itself

down to the simple point of fight or no fruit. You can't show me an orchard in this section where they had peaches last year and will have any this. There is no possibility of southern Illinois, or ourselves, having a crop next year. I am getting discouraged. Perseverance and energy will save us; nothing else will. I remember the time when, in this neighborhood, a man would have been kicked out of society if seen with his boots blacked. I hope to see the time when he will meet the same treatment should he harbor curculios.

American Wood Preserving Company.

The agent exhibited various specimens of larch, pine and other wood saturated by a new process understood to be of resin, or something similar, giving the wood density and a fine color. The process is said to be carried on at a small cost, and if it is what is claimed, it must be of great value to the country. Further information is to be given next week, on which occasion J. B. Lyman is to read a paper on the destruction of our forests.

Isabella grapes, grown by Mr. R. L. Pell, Esopus, N. Y., were exhibited, ripened by a new process, ten days in advance of the season.

Mr. A. S. Fuller.— This is probably by ringing the bark which is not new, nor are the grapes ripened, for they are congested with a species of dropsy.

Adjourned.

September 22, 1868.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Tomatoes.

Mr. Isaac Hunting, Pine Plains, Dutchess county, N. Y., referring to an account published of William Parmelee's superior tomatoes raised on a sandy plain near New Haven, says that he has the Feejee variety and they grow to immense size. One of them weighed eighteen ounces.

Mr. Wm. Lawton asked how to prevent the vines from occupying so much space.

Mr. A. S. Fuller.—The treatment is analogous to that of grape vines. When they have set three or four bunches, or as much as they will ripen, nip out the terminal shoots with the thumb and fin-

ger, and if laterals push out, so as to be troublesome, treat them the same way, or clip them off with a knife.

Leather Shavings.

Mr. J. Russell, Passaic county, N. J., inquired whether leather shavings obtained for nothing and composted with swamp muck and lime would be valuable as manure on poor land.

Mr. A. S. Fuller.—That treatment is very proper. I have found the fermenting dung heap a good solvent of leather. Cut small, I have known the pieces of leather to quite disappear in the heap of horse dung.

Mr. James A. Whitney.—I recommend that he use them as bedding, and get them well soaked and filled with organic matters. They will decay much more rapidly.

Mr. P. T. Quinn.—Unless he does something of that sort his leather will do him no good for a long time. On the Mapes farm we used some leather scraps as manure some sixteen years ago, and the other day some of the pieces were turned up very little affected by the moisture of the soil. If he should use a little diluted muriatic or sulphuric acid on them the decay would become rapid. Lime will take out the tannic acid and then hasten decomposition.

Mr. N. C. Meeker.—I have always found great benefit from the use of all the old leather I could get hold of.

Ground Bones.

Mr. A. S. Fuller.—I have received a letter from Peck Brothers, of Cornwall, Connecticut, asking me to propound this question to the Farmers' Club: Which are best manure for the soil, greasy bones or dry bones? They have a mill for the purpose of grinding bones, and it is of some importance to them and their customers to know.

Mr. J. B. Lyman.—Grease of itself has little or no value as manure. But bones that have not been boiled contain more albumen, that is, more nitrogen than boiled or bleached bones. This albumen is of great value as a prompt and stimulating manure. Such bones would act at once, and very perceptibly, on the first crop. The chief and permanent value of bones is for the phosphate of lime which they contain. This is as great in bleached as in fresh bones. I would say that for the first crop raw and unboiled bone is worth a quarter more than dry bone meal; after the first year, no more.

The regular subject of the day was now taken up:

THE PRESERVATION OF FORESTS AND OF WOOD.

Joseph B. Lyman read the following paper:

Gentlemen of the Farmers' Club.—I propose to read you to-day a few suggestions and a few facts. They are in a condensed shape, and were made from a good deal of reading, much personal observation, and a number of letters from farmers in different parts of the Union.

The mischiefs that I hope to do something to stop are twofold; first, the wanton and avoidable cutting of trees, and the carelessness with regard to wooden structures, by which it becomes necessary to cut timber to meet a useless waste.

Just now, in the history of our national development, is the time to arrest attention and enforce a wise and economical legislation on this subject. The Atlantic seaboard has been stripped of its forests to such an extent that one-third of New England would pay better if suffered to grow up to forests than it does now in grazing land; for a thrifty woodland is better than a poor pasture. In older countries the proper relation between woodland and farming surface has been carefully studied. The French writers conclude that thirty acres in 100 should be forests. The Germans say that on the sea coast one acre in five is the least, and in the interior every fourth acre should be woodland. According to this rule most of the hill tops and crests of ridges in Vermont, New Hampshire, Massachusetts, Connecticut, and New York, ought to be given back to forest, from which they should never have been redeemed. West of the mountains no more wholesale destruction of forests should be suffered, for the prairie region is very large. In the southwest and also on the shores of the great lakes, many thousands of acres of forests may yet be cut, but it should be done economically, as wood is demanded, not simply to lay bare the surface. We have over 40,000 miles of railway in this country. The average life of a railway sleeper is seven years. There are 2,112 in a mile. The average cost is fifty cents each. Thus our sleepers are costing us $150 a mile every year for each of the 40,000 miles in the Union. The sleepers on the English roads last, on an average, fourteen years, and when properly treated with preserving substances, they last for a century. The wooden structures on the farms of this country cost $3,000,000,000 every thirty years, or $100,000,000 each year. By the use of simple and cheap preservatives the duration of all this wood could at least be doubled. Thus the care and the saving for which I plead, if generally practiced,

would save this country $4,000,000 every year in railroad ties and $50,000,000 in fencing and farm buildings.

There are two situations, and only two, in which wood is not attacked by decay; where sound, well seasoned timber is kept perfectly dry, and where it is kept constantly immersed in water. The timbers in the roof of Westminister Hall are known to be 450 years old. The carvings on the stairs are 300 years old. Some of the interior of the Basilica at Rome has not been renewed for 1,000 years. The piles of old London bridge are still sound, though sunk in the mud of the Thames 800 years ago. There stands in the altar of the old brick church at Wetherby a table made from the oak of the first structure for worship in the place. The trees furnishing this timber must have been cut 230 years ago. But nineteen-twentieths of the timber in constant use is subjected to alternations of moisture. When those alternations are extreme, and no care is taken to preserve the wood, with most kinds of timber rot begins in from three to five years. A few instances are known in which yellow locust, red cedar and mulberry have lasted as gate posts or in fences fifty years. From inquiries of a great number of farmers, I think the average duration of fence posts in this country is about fifteen years, and of rails about twenty years. The aim of inventors has been to develop a process for preserving ship timbers and wood used for manufacturing purposes. It is certain that no process can be of practical value to the farmer which is nice or complicated or expensive. Hence the mode by forcing copperas and zinc in solution into the pores of wood, granting that it is effectual, will never benefit the farmer.

Why Wood Decays.

Wood is mainly made up of woody fibre, and a substance full of nitrogen. The fibre is of itself able to resist decay for a long time. But the nitrogenous matter is as liable to decay as cheese or the white of an egg. Hence the first thing to be done is to dry up, or to fix, or to expel, or to stiffen this nitrogenous matter so the air and water will act upon it slowly or not at all. If wood is first soaked in water and then thoroughly dried it is found to last much longer. Why is this? Because the decaying substances are partially dissolved in the water and soaked away. Drying afterwards carries off the water, and if moisture can then be kept from it decay will be greatly retarded. If the water in which wood is immersed is kept boiling for some time, this substance is stiffened like the white of a

boiled egg, and the wood will last at least twice as long in consequence. Woods differ greatly in the fineness of their grain. This is illustrated by the difference in hickory and chestnut. But the fine grained wood generally decays quicker than the coarse grained, because the air cannot penetrate the fine grained wood so as to dry out the sap and stiffen the albumen. This is why a chestnut rail will outlast three of hickory, while in an axe helve, hickory will outlast a dozen of chestnut.

The best process for preserving wood would be one that should first expel the sap, then fix or coagulate the albumen, then load the pores of the wood with a substance that will resist the action of moisture and keep out the air. The processes of Burnett, Kyan, and Boucherie, consist in injecting, by different means, the metallic salts of zinc, mercury, or copper, into the pores of the wood. These processes are all expensive, and in this country have proved unsatisfactory. The methods of Bethel, Seeley, Robbins, Prindle, and the process of the American Wood Preserving Company, consists in forcing, by means of heat, steam, or hydraulic pressure, resinous and oily substances into the wood. It is obvious that a method which shall, by an inexpensive apparatus, force into the pores of wood a cheap, yet firm resin, able to resist the action of air and water, will come nearer accomplishing the desired result than anything else. Without reciting the chemistry and learning of the subject, the farmer may be benefited by the following summary:

1. Timber that grows on dry, rocky soil, unsuited to the plow, is firmer and more lasting than wood grown on moist and rich soils. Hence millions of acres that are now poor and profitless pasture would pay better if allowed to grow up or if planted out with forest trees.

2. In planting forests, the trees to be selected are locust, the rock maple, black walnut and the European larch. On rough and rocky lands the locust and the rough bark hickory will grow with more profit than other trees. On the prairies that tree should be planted which is found to resist the sweeping winds most effectually and to flourish best on the prairie soil.

3. The planting of trees on road-sides ought to be specially encouraged by local legislation.

4. In using many kinds of wood, and especially chestnut and sappy pine for shingles, pickets trellises, etc., much durability will be gained by boiling in lime-water or a weak solution of carbonate of soda. The boiling coagulates the most perishable parts, and the alkali

corrects the acid of the sap, and prevents the growth of fungus. Whitewash is to be recommended as a valuable preservative of wood for a similar reason.

5. Fence posts should be well seasoned and treated by boiling the end to be set in the ground in tar or rosin. For a foot each way from the surface of the earth, when set, fence posts should be well coated with a paint that will exclude water. Setting posts top end down does increase their durability.

6. Painting green wood is worse than useless. It promotes decay by shutting out the air which would stiffen the albumen beneath the surface.

7. This subject is of interest to every man who has a door-yard fence to build, and whose land is not worth more than seventy-five dollars an acre for agricultural purposes.

8. The efforts of inventors should be directed to methods of treating cheap and inferior timber, such as spruce, hemlock and chestnut, so it will be equal to the most valuable, as white pine, black walnut and yellow locust. Making all our walls with wood should also be discouraged. Stone, brick, or concrete are better and but little more costly. It is time to arrest the lavish and wasteful use of the best building timber. It would be well to consider whether stone or iron, with a cap of some springy material, as India rubber, may not be substituted for wood as sleepers on railroads. Iron and stone ought to replace wood for bridges, and especially railroad bridges; and last, the material interests of the present and the coming generations would be greatly advanced if one third of the cleared surface east of the mountains were given back to the dominion of useful forest trees, of which all our steep and rocky lands should never have been wholly cleared.

Dr. J. V. C. Smith.—I have been very much entertained and instructed by this paper on a subject of the utmost importance to the whole country, and I think this paper ought to appear in the proceedings of the Institute. Wherefore, I propose that Mr. Lyman be requested to furnish a copy of his paper for that purpose.

The motion was seconded by Mr. P. T. Quinn, and carried.

Mr. Horace Greeley.—I have followed the essayist with attention; and to what he has said, all of which is excellent, I would add two suggestions:

1. Farmers must keep their cattle out of forests, if they would have valuable timber. I have some twenty-five acres on which I di not get ten rock maples till I fenced it, now I have at least 500.

2. Farmers must learn not to cut down, but to cut out. In all woods there are many poor, crooked trees. Cut these and make room for better wood to grow; but never strip a woodland at once of its growth. When a forest is thus thinned, seed should be sown in it. For instance, I this fall sow thirty pounds of yellow locust seed on a rocky crest. It will do me little good, but the next generation will draw a larger revenue from those locusts than they would from twice the area in common pasturage.

Mr. P. T. Quinn.—I would ask Mr. Greeley his opinion as to the increased productiveness of lands on account of the presence of timber on the hills.

Mr. Horace Greeley.—If I had 100 acres of pasture and mowland in a rolling or hilly country, I would keep twenty-five in woods and get more grass from the seventy-five that were in grass, than I could by stripping the hills and putting all in grass. Timber on hills has two effects. It makes the vales warmer from protection, and it increases the amount of moisture. For this purpose I especially value the hemlock, among the evergreens.

Dr. J. C. V. Smith.—Nature has a process of preserving timber, which it is singular men have not imitated. The bog-timber of Ireland, found in their peat bogs, is thousands of years old, and the art of obtaining it has been reduced to a science, so to speak. With an iron rod the timber is found lying deep in the bog, and the operator can tell the length and dimensions of a tree, and whether it is suited for wagon hubs, or for uses requiring less durable wood. Last year, when the river Po, in Italy, was at a low stage, some piles which were driven by Julius Cæsar, for the purpose of crossing by a bridge, were discovered, and they were in a sound condition.

Mr. Horace Greeley.—I doubt that very much.

Dr. Isaac P. Trimble.—That story is not incredible. In a Cypress swamp in North Carolina, I have seen a tree eleven hundred years old, growing right over a fallen stick of timber, in the mud, that showed an age of nine hundred years, and perfectly sound.

In this connection Mr. Theodore Heinemann was introduced as the inventor of an

Improved Process for Preserving Timber.

Mr. Heinemann said that the subject of wood preserving had been so exhausted by the wise suggestions of the previous speakers that anything further from him must appear unnecessary and arro-

gant; he would therefore confine his remarks to his invention as a special topic. Some years ago he was called upon by a gentleman largely connected with ship-building on the Clyde (Scotland) and requested to examine into the merits of a patented process for the preservation of wood. This led to a thorough investigation of all processes ever proposed or used for that purpose, and after analytically ascertaining the reasons why some of them failed totally, others succeeded partially, but none fully, he came to the conclusion, at which the several speakers and the club generally had arrived, that the only policy, which promised success, was to follow in the footsteps of nature; that no treatment could succeed unless it extracted or destroyed the nitrogenous substances of the wood, and filled the pores in such manner as effectually to protect them against the alternate conditions of moisture and dryness, heat and cold.

This was most perfectly done by his process. He placed the wood in a tank, boiler or retort, one end of the wood higher than the other; adds sufficient resin, when liquified, to cover the wood, and having poured in a slight quantity of water, closes the boiler and applies heat. The first effect is to convert the water which was poured in, as well as that contained in the pores, into steam, which softens the wood and opens the pores. Then, after the heat has risen to 275 degrees Fahrenheit, and the pressure to forty-four pounds per square inch, the resin begins to melt and trickles slowly down, its level raising as more and more is melted, and as the level of liquid resin raises it enters into the pores of the wood from below, displacing and driving out the steam above. At the same time the great heat utterly destroys the nitrogenous or albuminous principles of the wood, and after a few hours the wood is thoroughly impregnated.

He then exhibited a very beautiful and extensive array of specimens, among them large sticks of hickory, maple, birch, soft pine, spruce, hemlock, etc. All the specimens were thoroughly impregnated in all parts, and Mr. Heinemann stated that he could, with equal facility, saturate the pores of the longest and thickest sticks or trees.

The qualities of these woods are wonderfully improved, the treatment having increased their *hardness, density and strength, and greatly beautified* them, making them to resemble rosewood, ebony, black walnut and mahogany, for which they will most probably become valuable substitutes. It makes the wood perfectly impervious to water; one piece which had been immersed for forty-two

days, had not absorbed a single drop, while another piece of the same kind of wood, but unsaturated with resin, within forty-eight hours became thoroughly water-soaked, having absorbed more than its own weight.

Mr. Heinemann then stated that he could quote hundreds of volumes of evidence that the ancient Egyptians had used nothing but purely resinous substances to preserve their woods and mummies, and therefore he could claim these as practical proofs, that by a process essentially like his, vegetable and animal tissues had been preserved for several thousand years.

Mr. Heinemann then further produced testimonials from Prof. R. Ogden Doremus, the well-known chemist, who states that he has thoroughly inquired into his process and analyzed his specimens, and indorses the remarks made by Mr. Heinemann in unqualified terms.

Mr. A. S. Fuller then asked what it would cost to treat a thousand feet of lumber.

Answer.—From two dollars and fifty cents to three dollars.

Mr. A. S. Fuller.—What would a railroad tie or fence post cost.

Answer.—A railroad tie from ten cents to fifteen cents; a fence post from four cents to eight cents. An apparatus to treat a thousand feet per day would cost from $300 to $500.

Mr. Horace Greeley.—Is it necessary that the wood should be well seasoned?

Answer.—No. Wood from a tree cut down the day on which it was treated, turned out fully as good as well seasoned timber. Green wood takes less time to saturate and absorbs more resin.

Mr. H. then stated that he had connected himself with the American Wood Preserving Company, of 42 Broadway, New York, for the purpose of introducing his invention, and that they had already received propositions from several railroad companies, dock and bridge builders, and ship owners. Millions of money and thousands of human lives were annually lost through the accidents caused by rotten sleepers and worm-eaten ships' planks; if he could be instrumental in saving some of these valuable human lives, all his exertions and the labor of his life would be simply repaid and he would feel forever thankful to his Creator for having made him instrumental to so worthy purpose. The club received Mr. H.'s remarks with many marks of gratification and approval, and indorsed his views, particularly inasmuch as there can be no doubt that wood impregnated with resin, by his process would outlast many generations.

Mr. Wm. Lawton.—I was especially pleased with the suggestion in the paper that lime is one of the cheapest and best applications to wooden surfaces. I have fences that were whitewashed twenty-five years ago. They were not new then, and the palings and rails are sound to-day. Lime corrects the sourness of the sap, and prevents mould, mildew and mosses from attacking timber. These, when once started, destroy wood very fast.

FOREST FENCES.

Dr. I. Jarvis read a short paper on the subject of the day. He thinks a narrow belt of mixed woods, such as chestnut, pine, hemlock, laurel, beach and cedar could be planted on lines between farms, and soon become a fence that would at the same time add to the beauty of the estate, furnish some wood and timber, nuts and fruit, be perpetual and indestructible.

THE WALTER GRAPE.

The committee appointed to visit the Walter grape, grown by Ferris & Caywood, report that they went to Poughkeepsie and saw the vine well loaded. The fruit resembles the Delaware in appearance, and it is as large as the Diana, from which two varieties it is claimed to have been derived by hybridization. It is as good as the Delaware, though without its watery sweetness, and it does not have the peculiar and objectionable flavor of the Diana. The foliage is much more vigorous than the Delaware; it approaches the Concord in roughness; it is without the wooly covering on the under side of the leaf, and it seems to be a vigorous grower and healthy. The period of ripening is said to be that of the Hartford prolific, which is our earliest fine grape; but it does not drop its fruit like this variety. As to the claim that the Walter will make a raisin of any quality, we saw no specimens and had no evidence.

We should not neglect to state that the soil in which the Walter is grown is a clay loam mixed with gravel and much slate, and that a bed of gravel of considerable depth lies below, giving complete drainage, and the location is about a mile from the Hudson river, and several hundred feet above it, all of which conditions should be favorable for grape growing. From these facts, we conclude the Walter should be a valuable grape in the grape regions of the Upper Mississippi, on the shores of Lake Erie, in western New-York, on

the slate soils of western Pennsylvania, and wherever else native grapes are successfully grown.

N. C. MEEKER,
J. E. SNODGRASS,
JOSEPH B. LYMAN,
A. B. CRANDALL,
SERENO EDWARDS TODD,
Committee.

Mr. P. T. Quinn.—A year or so ago, Mr. Caywood exhibited some leaves said to be from this vine, and from its vigor and toughness I think the country is indebted to him.

Dr. J. E. Snodgrass.—It was not the business of the committee to give decided opinions, but to relate what they saw and learned. It would be worth the time of such as are interested in propagation to visit the grounds of these gentlemen, and see on how vast a scale their business is conducted.

Delaware Grapes.

Mr. C. W. Idell, West Washington market, presented fine specimens of this variety, grown by Mrs. Bronson of Hammonsport, showing that the locality is well suited to this fruit, and that a new occupation is open to women.

The great Need of Southern Shippers and Growers.

Mr. S. B. Conover, West Washington market, N. Y.—They do not fully understand the picking, and the proper mode of packing their fruits and other produce to come to this market. A large proportion of the shipments, from the want of proper packing, have arrived in bad condition, and consequently have been a losing operation. There are settled rules which govern sales here, such as barrels, bushels, and baskets. The shipments should be made in such sized packages as would conform to the above, and to make the packages of a uniform size. If barrels are not within reach, a crate holding one and a half bushels or half a barrel should be used for Irish or round potatoes, sweet potatoes, cucumbers, beans, peas, apples, and onions. The crates should be made of two end pieces and one middle one, 18x8 inches, and about one inch thick, and slats nailed on twenty-seven inches long, so as to make the crate inside measure 18x8x25 inches. The slats should be from two inches to six inches wide, and about half an inch thick, leaving an opening between of one-half to one inch in width. The

above sized crate is convenient to handle, will keep the contents ventilated and cool, and two of them will make a barrel, the standard measures for the above articles in the market. For peaches, tomatoes and pears, the crates should hold two of our peach baskets, and made of ends and middle pieces, 8x18 inches, one inch thick, and slats twenty-four inches long, from two to six inches wide, and about one-half inch thick, with spaces one-half to three-quarters of an inch. This crate will hold one and one-quarter bushels heaped measure.

Too much care cannot be taken in selecting and packing fruit and vegetables to ship long distances, as fruit or vegetables that are worthless at home are worthless here; besides they spoil that which would come good if properly selected. The following rules should be observed in packing and shipping: Potatoes should be of good size, the skin well set, and care taken in digging, not to let them lie in the sun so as to scald, for a few sun-burnt potatoes in a crate will ferment and rot the rest. The crates should be well filled and shaken down. Cucumbers should be of the pure white spine; they should be picked before they get their growth, that is of medium size, as an over-large cucumber is not valuable. Be sure that there are none that show the least sign of turning yellow, and fill the crates well. Onions should be pulled and thoroughly cured, keeping out scalded or bruised ones, and when packed should be perfectly dry and shelly; cut the top so as to leave about an inch long. Apples should be perfectly sound and not wormy; put them up so as to have them of uniform quality in each crate; use care in picking and packing not to bruise them, as they soon spoil when bruised. Fill the crates well that they may not shake in handling. Beans and peas should be perfectly dry when packed, rejecting all bruised or rotten ones; the crates well filled; they should be sent off when young and tender, as beans that will not snap are not saleable. Tomatoes need more care than most any other vegetable. They should be of the large, smooth, red variety; yellow or rough tomatoes are not saleable. They should be picked as they begin to turn red and in dry weather. They must be selected with care, rejecting any that are bruised, cracked, or wormy; put in crates carefully, shake them down and well fill, as a few bruised, cracked, or ripe tomatoes soon ferment and rot all the rest. Do not pick before they commence turning red nor after they are nearly ripe. The same care should be used in picking and packing peaches; have them perfectly dry, sound, and within about five days

of ripening; pack carefully; reject all bruised ones; well fill the crates, shaking down so that they will be tight and not move in handling.

Mower Sharpener.

Mr. D. W. Ayres, Chicago, Illinois.—This was exhibited again as it did not have a fair chance last week. It has the advantage of being as portable as a bit-stock; the mower is sharpened as well in the field as elsewhere, and while in running order, and after a little experience the proper bevel is easily kept. Todd, Meeker, and others of the committee thought it simple and complete; and David Pettit, that good quaker farmer from Salem, New Jersey, pronounced it unequaled.

Adjourned.

September 29, 1868.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

The Use of Straw.

Mr. W. S. Rhett, Windham, Wyoming county, Pa., stated he had quite a quantity of wheat straw, and was at a loss how to use it, as he has no barn-yard. There is one field of ten acres, which is poor, and he had a muck swamp within a few rods. Advice was wanted.

Mr. J. B. Lyman.—This gentleman says he has no yard for rotting straw, then he has no suitable arrangement for making manure, and does not make as much money as he ought to at farming. Or if he makes money it is taking the marrow out of his land, so he will soon have some more badly run fields of ten acres like that he asks about. As a rule the Pennsylvania farmers have the best barns and yards in the country. They often lodge their cows and oxen in a larger and more costly structure than the family residence. There are two uses for straw as an absorbent of liquids around animals and as fodder. The English farmers, who formerly used straw very freely for littering all their animals, are now of opinion that it pays better to cut the straw, steam it, mixing meal or roots with it and feed it out to farm stock in cold weather. Straw, as food, gives very little strength, hence, for working animals, it will not pay as well as if fed to store cattle and yearlings. But it should always be mixed with meal or cotton seed cake, or shorts. Why not let it rot in a pile and use it as manure? Because if animal matter is mixed with decaying straw,

both are benefited and made better as fertilizers, and because it is needed as an absorbent of the liquids of a farm-yard. The same correspondent asks if wheat grown from that which had sprouted in a stalk is as good as any for seed. Yes. He speaks of four bushels to the acre. That is an extravagant allowance. The best wheat growers sow in the drill, and use less than two bushels per acre.

Ornamental Hedge.

Mr. J. Elliott, Putnam, Conn., inquired whether the Osage or Arbor Vitæ would be most suitable for quite an extensive front.

Mr. A. S. Fuller.—The Arbor Vitæ, decidedly. The Osage makes a coarse hedge, and requires much trimming to keep in order. The Arbor Vitæ can be bought in the spring for about five dollars per 1,000, at which time they are to be set in nursery-rows, well cared for, and mulched, and if they grow well, they can be set out permanently the next spring; otherwise, the spring after.

Mr. J. B. Lyman.—I have traveled a considerable in Connecticut, and find very few Osage hedges which have withstood the cold winter.

Prosser, or Burlington Raspberry.

Dr. J. M. Crowell inquired its value.

Mr. A. S. Fuller.—I have condemned so many humbugs and swindles, that they call me an off-ox; but somebody must stand such things, or there is no protection. I heard a great deal of this raspberry; it had sold high, and in one place I know of, at $1.20 a dozen. I went to Burlington to see it, and was shown a little inclosure where there were four distinct varieties of raspberries. I asked the young man in charge which was the Prosser, and he stared at me, but finally said I might take my choice. Mr. Parry, of Cinnaminson, got a small lot of three varieties, and said if he had got another he would be certain of having the Prosser. Don't we want some authorized propagators at Washington, to test new varieties, since those selling them seem incapable, either for want of honesty or knowledge?

Horse Radish as a Crop.

Mr. H. Peck, Norwich, Conn., asks for information about this plant.

Mr. J. B. Lyman.—Peter Henderson, of Jersey city, raises more of it and makes more money from his crops, than any cultivator around

New York. He has written a valuable book, which the club recommend to Mr. Peck as the best guide.

Preservation of Wood.

Chairman.—We have with us to-day a gentleman who should have been present last week, when Mr. Lyman read his paper on protecting wood from decay and insects. He was one of the first in this country to suggest a practicable treatment; he will give us his ideas in brief.

Dr. Lewis Feuchtwanger gave an account of his early experiments, and concluded by saying that wood boiled first in lime water, and then coated with silicate of soda or liquid glass, will last a very long time. The mixture is fifteen per cent alkali and eighty-five per cent pure sand. Badly rusted cannon balls painted with it in the yard, had the rust arrested many years, while their surface had a fine polish.

Mr. James A. Whitney.—While this will preserve the timber, the action of the alkali will be to weaken the fibre. Hence, for bridges where strength is important, it would not answer.

Keeping Butter and Eggs.

Mr. Edward Smith, Orrington, Maine.—I am not a farmer, but a master mariner. I have conveyed my butter to the East Indies and back perfectly sweet, and have crossed the line four times with the same butter on board, and the last year was as sweet and nice as the first year after packing. First, see that your buttermilk is well worked out. Then pack in twelve pound oak kegs, perfectly tight. Then pack your kegs in an oak barrel, and keep the kegs covered with brine made from Turk's Island salt. Keep them under the brine with a weight. In one year after, if good butter is put in, good and sweet butter will come out. Or you may pack the kegs in Caddie's salt, by having it well pounded in around the kegs. But the first I prefer.

For Eggs.

To every three gallons of water add one pound of fresh slacked lime, and one-half pint of salt. Have it well dissolved. Drop in your eggs one at a time, but mind you do not crack them. If you wish to keep them one or two years you can do so. But you must use them as soon as taken out, or they will spoil. When you put all in you wish, take a thin piece of board and put on top, and on that

put a little salt and lime that the top may be as strong as the bottom. If these are kept at sea and in different climate, why not keep them on land and in a cool cellar. Should you wish to keep to transport, dissolve sufficient gum shellac to make a thin varnish in alcohol, let them dry, then, after giving each egg a coat, pack them in bran or sawdust. When wanted wash off the varnish, and they are ready to cook or to set for hatching. This is not from hearsay, but from experience.

Adjourned.

October 6, 1868.

Mr. NATHAN C. ELY, in the chair; Mr. JOHN W. CHAMBERS, Secretary.

PRUNING INSTRUMENTS.

A correspondent inquires what tool is best for pruning.

Mr. Wm. Lawton.—I can do three times as much work with an ordinary, old-fashioned sickle, than with the best garden shears.

Mr. Horace Greeley.—I am glad that this question has come up. Though much progress has been made in gardening and fruit growing, still much remains to be learned. Our gardeners work with poor tools and at a great disadvantage. We cut up our land into small irregular sections, so that animal labor cannot be applied. Our gardens are not established with a view to aid, but rather to embarrass labor.

Mr. Henry T. Williams.—I have fifteen acres, laid out in such a manner that the rows may be plowed or cultivated both ways. My garden took the premium last year for being the best kept garden in the county.

Mr. J. B. Lyman.—We need better hand-cultivators than we have now. Some are adapted to sandy land, and will not work at all on stiff soils. The cutters should be so adjusted as to suit various conditions of surface. Much progress has been made in gardening. Onion culture was formerly the most laborious and exacting of root crops, and it took from seventy to eighty days to raise an acre. Now only fifty days are required, and with improved instruments, less time would do.

Mr. A. S. Fuller.—By making long, straight rows, you destroy fine effects. A curve is the line of beauty.

Mr. P. T. Quinn.—A garden can be laid off in such a way as to look well and still allowing long rows. The more turns a horse makes, the better he works and the less he is fatigued.

Feed Cutters.

Correspondent asks which is the best.

Mr. E. Williams, Montclair, N. J.—None of them are good for much.

Mr. A. S. Fuller.—That's what I say. I give my horses long hay and whole oats, and I will give the reason for it. Some time ago I sent my wagon to mill for a grist of provender. The miller is honest. Oh yes, as honest as any man in the State of New Jersey, and when it came home there was one bag that had oats in it. I looked at those oats. They were nothing in the world but oat chaff; not kernels enough in the bag to lunch a young gosling. I went to that miller quick. Says I, do you call those things oats? Is that what you grind up with corn and sell it for provender? Yes, says he, Mr. Fuller. I'll be honest with you. I have to buy them kind of oats to make anything on my provender. Now, Mr. Chairman, that convinced me. No more provender and cut feed for A. S. Fuller.

Mr. Solon Robinson.—I would like to see the man who will stand up and say that he *knows* it does any good to cut hay for fodder.

Dr. J. V. C. Smith.—Mr. Chairman: The alimentary process is very wonderful, and common people do not understand it. There must be expansive pressure on the interior coats of the stomach and entrails. A dog in a shipwreck lived twenty-one days on the lids of a Bible. It was not any of Kit Burn's dogs either, but a common cur. Now what kept him alive? Not the leather alone. It lay in his stomach and prevented the gastric juices from acting on the coats. This proves that all hay cutters are bad. The best feed cutter is a pair of strong jaws.

Dr. Jarvis.—Mr. Chairman: We can never make true progress in the art of fattening men and animals till we are fully impressed with the immense importance of the process of deglutition.

Dr. Trimble.—I indorse the ideas of my learned confreres. Dr. Smith, in particular, I regard as eminently wise and sound in his ideas of mastication, deglutition, and the subtle but marvellous function of the pancreatic juices and the mesenteric glands. Therefore, my voice is against hay cutters.

Mr. P. T. Quinn.—Mr. Chairman: What would an English farmer think were he to step into this club and hear us gravely discussing the propriety of cutting food for animals? He would think that either he or we had better go back to the farmer's alphabet. You call for facts. Why, it was settled long ago, in England, after careful experiments, that nineteen pounds of cut hay are equal to twenty-five

pounds of long fodder for producing muscle or fat. I know that if I were to throw away my feed cutters my plowman would come to me within three days and say: "Mr. Quinn, I cannot keep my horse in good condition on long fodder." Why is this club forever meddling with first principles, and laboring to upset the axioms of our profession? We will become the laughing stock of the civilized world, if we continue to advance theory in the face of solid facts. Solon Robinson calls for a man that believes in cut feed. Mr. Chairman I am the man. An experience of eighteen years has convinced me that my animals do better on cut food than on any other. This is, or would be, the testimony of thousands who devote their working hours to the care of stock. If the kind of reasoning that we have heard here to-day continues, our professors will be saying, by and by, that grist-mills are useless and should be burned.

VINEYARDS AND CRANBERRY GARDENS IN SOUTH JERSEY.

The committee of this club appointed by the chair to visit the cranberry plantations of Ocean county, New Jersey, and a remarkable vineyard on Barnegat bay, submit the following report of what we saw and learned: We went to Toms' river, near the upper extremity of Barnegat bay, and taking carriages, rode for about ten miles nearly south through a great sandy plain. The country bore marks of frequent and extensive fires. We passed through 20,000 acres belonging to one man, and 14,000 acres adjacent belonging to another man. The growth upon these extensive tracts is almost wholly small pines, with bushes or shrubs of oak. We passed two or three considerable streams, on the margin of which were cedar swamps. The surface does not appear to be more than twenty or thirty feet above tide-water. At the distance of two miles from a village called Forked River, which is seven miles north of Barnegat, we passed across a tract of 1,000 acres belonging to D. H. Tichenor, of Newark, a small part of which, seventy acres in extent, has been cleared and brought into cultivation. It is owned and tilled by E. R. Spaulding, who purchased the tract last spring from Mr. Tichenor. The soil of this farm does not appear to be essentially different from that of the large uncultivated tracts through which we had been journeying. The surface undulates slightly, the higher parts being of a sandy loam, and the lower portions of a yellowish gravelly nature. On the sandiest part of the tract there has been established a vineyard of something over four acres in extent, two and a quarter acres being in

full vintage this year. The vines, mostly Concords, six feet asunder one way and four the other, trained to stakes. We estimate the quantity of fruit to be seven pounds on each vine. The summer pruning has been a little too close, so the ripening was rather uneven, but ten days or two weeks more of sun, no doubt, brought the grapes to fine marketable condition. The price he obtains is from twelve to fifteen cents a pound. It thus appears that the income from each of the two acres in fruit will be over $1,000 per acre. The soil had been fertilized by a few loads of mussels composted with swamp muck. We regard this vineyard as a proof that the millions of acres of untilled land in south Jersey are, in their soil and climate, admirably adapted to the growth of the grape; and the Concord at least grows and fruits luxuriantly in this soil, with but a slight dressing of inexpensive manure. Mr. Spaulding's corn was also noteworthy, as showing what remarkable results follow the use of a little nitrogenous manure in this sandy soil. Some parts of the field were fertilized at planting with two moss-bunkers in a hill. Here the yield was thirty-five bushels per acre. When no fish were used the crop was small, about eighteen bushels to the acre. Where a compost of muck and mussels had been applied the corn was large and the estimated yield as high as sixty or sixty-five bushels per acre.

Remarkably fine watermelons were produced in great quantities by an application in the hill of a compost of muck and hen manure. We remark this as proving that all these wild lands on the Jersey shore can be made to yield excellent crops by the use of fertilizers that are cheap and abundant.

On the day following our visit to this farm and vineyard we went over a number of the cranberry gardens or bogs near Manchester. The best we visited was that of John Torry, Jr. It covers seven acres, is of water level or nearly so, wholly free from grass and weeds. He called our attention to what he regards as an innovation and an improvement in the culture of the cranberry. When the vines are two years old the growth of the runners becomes very rank, and they lie one upon another, making an elastic bed several inches thick. When this is the case only a few of the lower runners can touch the sand so as to derive sustenance from the earth. To remedy this, Mr. Torry covers his vines in all places where the growth is rank with two or three inches of sharp white sand. This presses the vines down and beds them in the soil, and they produce largely. None of the bogs are yielding full crops this year. Mr. Torry will proba-

bly take 700 or 800 bushels from his seven acres. We saw a bog of fifteen acres which is now being put in by General John S. Schultze. It is a model of tasteful, thorough and accurate planting. The lines of plants are mathematically straight from one side to the other, and the area is divided by sub-ditches, which cut the bog into sections of half an acre each. His expenses per acre will be about $225, and the work is in all respects careful and admirable. He is likely to have the handsomest and most productive bog in Ocean county. After an outlay of about $250 for the land and planting, a cranberry bog calls for very little annual expense, and yields on an average 150 bushels per acre, which sell at four dollars, and this year probably at five dollars per bushel. There is no agricultural property in the country which can compare with a cranberry garden in profit.

JOSEPH B. LYMAN,
A. B. CRANDELL,
S. EDWARDS TODD,
E. WILLIAMS,
A. PRETERRE,
Committee.

Mr. A. S. Fuller.—Though this report is carefully written, and shows careful observation, there are one or two suggestions that should be made. The fact that one flourishing vineyard has been established in a clearing of south Jersey, does not prove that all sandy plains are good for grapes. The grape does well on all new lands; and its history shows that, like the buffalo and the Pawnee, "the star of empire westward takes its way."

Mr. P. T. Quinn.—I do not think it safe for us to say that $225 per acre will establish a cranberry garden. More than one cranberry man has put $800 into an acre before he got enough to pay for fencing. In many of the south Jersey bogs, the grasshoppers did great damage.

NEW DISCOVERY IN TANNING.

Mr. Orville M. Tinkham exhibited some fine specimens of soft, pliable and apparently well tanned leather, on which no bark juice had been used. The process is the invention of Ira Wood, of Vermont, and it consists in getting an extract by boiling forest leaves and using it for tanning. The exhibitor said that farmers can do a good business by raking up leaves in the woods and manufacturing this extract for tanners.

Mr. J. B. Lyman.—The idea of this invention is new, and it may be of great value. I move that the chemist, Mr. J. A. Whitney, be commissioned by the club to make infusions of various forest leaves, and learn by analysis the quantity of tannic acid they contain. At the same time it would be well if he could ascertain and lay before the community the exact amount of fertilizing matter contained in the ashes of leaves, and also the ash of such wood as oak, ash, chestnut, elm and pine. We need precise knowledge on these points, which, no doubt, Mr. Whitney may be able to furnish.

Mr. Jas. A. Whitney.—If I undertake this business I shall need several pounds of leaves and a statement of the soil on which the trees grew.

Mr. A. S. Fuller.—I will furnish him with a bag of them from my woods, and have no doubt but other members of the club will do likewise. If this idea of using leaves instead of bark proves a success, it will open a new channel to industry.

Grand Traverse.

J. E. Fisher, Glen Arbor, Lelenaw county, Michigan.—It has been said that the great enemy of apple trees in the Traverse region is the canker worm. Such is not the fact. In the season of 1865 the canker worms were numerous, but that was the only year that they ever did any damage since the settlement of the country. I am acquainted in many of the fruit bearing regions of the western States, and all things considered, that is, health, soil, water, climate, and facilities to market, I claim, from fourteen years observation, the Grand Traverse country superior for fruit raising ; and that the apple, plum, peach, cherry, pear apricot, and nectarine, are raised successfully, and have fewer enemies than in most fruit regions. The strawberry, raspberry, and quince also do well. In your note of reply to Mr. Voorhees, you seem to think that the chances are unfavorable to planting orchards on shares. Now here are hundreds of responsible men who can own plenty of land of first quality, but have no capital. They would jump at the chance to have capitalists furnish the means ; the settlers to do the labor and divide the profits. It surely can be made a paying investment to both parties.

Again, Eugene Lacroise, of Kansas, charges that the peaches here were mostly killed last winter. This has no foundation. I reside in the Traverse region, and have seen nothing of the kind ; I have over 1,000 peach trees of all sizes, from one to eleven years old, now

growing, and all of sufficient age are loaded with fruit; not a tree, not a limb, not a bud was killed last winter. At my place (Glen Arbor) the coldest morning, at a little before sunrise, last winter, the mercury stood thirteen degrees below zero. In a residence here of fourteen years I have never known the mercury to stand below zero all day. What few peaches were here in 1855 were injured, but none have been since. I state what I know and have seen. He also says the snow was sixteen inches deep on the 24th of April. The truth is the plow had been running for more than a month previous to the 24th of April. The snow went off about the middle of March, and many had finished sowing their spring wheat and peas before the first of April. A writer that lives in Kansas is too far off to be well posted about the Grand Traverse region. Many people land here from the boats, walk a little ways on the sandy beach of the lake, then imagine they know all about the Grand Traverse.

Adjourned.

October 13, 1868.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Dahlias.

Mr. J. Slam Burgess, florist, of Glen Cove, L. I., exhibited many specimens of these flowers, extremely large and fine.

Mr. A. S. Fuller.—Mr. Burgess is the only man now living who saw the first dahlias, of only six petals, brought from Mexico to England. No one would have supposed that such an insignificant flower would have developed into one so splendid as we see here to-day; and yet poor as it was, some could see signs of promise, and even paid as high as twelve guineas a dozen. Up to the year 1840 they were all single; after that improvements commenced, but it is only within half a dozen years that the greatest progress has been made. Here is a medal which Mr. Burgess received for dahlias in 1827, which was before I was born.

Mr. J. Slam Burgess stated that he commenced growing dahlias forty-eight years ago, and he had gone on until now he has 6,000 varieties. In Boston one man has 2,000. A new distinct dahlia is worth about twenty dollars, and often has sold for much more.

Bog Manure.

Mr. C. Hunt stated that on his farm in New England, there were fifty acres of sandy gravel soil, the remainder was muck or bog, and he inquired how it should be used to enrich his farm without the addition of lime.

Mr. Jas. A. Whitney and Mr. Solon Robinson said it would be cheaper to use lime, because the muck could be applied with good effect a year sooner.

Mr. A. S. Fuller.—I have used thousands of loads of muck without a particle of lime, and find it of the greatest advantage. On the farm opposite mine a large muck heap was in a corn field; there was no time to spread it, and in planting corn the men planted on it, and you ought to have seen what magnificent corn grew where the muck was four feet deep. No lime was used.

Mr. H. B. Smith, of Westfield, Mass.—A neighbor of mine has used muck many years, but without any apparent advantage. It is true that it was of the boggy wiry kind. I have tried muck with lime to correct the sourness, and derived a benefit the same year. But it should be understood that there are half a dozen kinds of muck.

Grass in Warm Climates.

Mr. A. Harroun, Apulia, N. Y.—I have noticed with much interest and some surprise the reiterated statements in the club about the great lack of grass in the southern States, which may be true, but it ought not to be, for there are valuable grasses that flourish in all latitudes, the extremely cold excepted. South America produces grass profusely over many thousand square leagues where snow never falls. Texas is almost as warm as Florida, and abounds in grass. California is noted for its fine pastures, of which grasses and clover form the staple over a large part of the State. Even the West India islands produce excellent grass and fine beef, or did once. Dr. Coke says of Jamaica: "Among the valuable articles cultivated for domestic use, the Guinea grass claims the first place. The introduction of this grass soon increased the number of grazing and breeding farms on spots where the hand of cultivation had rarely labored before, and the effects were soon rendered visible in the large supplies which at a moderate rate, crowded the Jamaica markets." He also speaks of another species of grass grown there which "has been found to be highly valuable," and which flourishes best on low or moist ground. If none of the valuable grasses can be domesticated in the southern

States, their soil or climate, or both, must be anomalous indeed. It is hardly possible. Who will make his fortune by supplying the southern States with grass and clover? Slavery has left sad marks of its power for mischief upon the minds and consciences of all classes of its victims, but it is to be hoped it has not so poisoned the air and perverted the soil as to make them obnoxious to one of the greatest and most widely diffused gifts of God.

Mr. N. C. Meeker.—Grass grows in warm climates, it is true, but when eaten close it dies out, because no sod is made. Society and grass are not found together in warm climates, and only skill, care, and time will bring grass in after it once is eaten out.

VALUE OF BROOM CORN SEED.

Mr. C. W. Carpenter, Mount Gilead, Ohio.—I do not think broom corn seed is good for stock; there is a dust with the seed, very poisonous and irritating to the skin, as all know who have handled it; horses and cattle that feed on it do not thrive; the hair looks rough; it irritates the stomach and bowels. A good way, if one has the seed, is to spread it around on the barn floor, and thrash it thoroughly with a flail, then clean all dust from it, mix it with corn and oats, and get it ground for chop; but the better way is not to have any broom corn seed; cut the brush as soon as the pollen has fallen, or it is out of bloom. A broom made from green broom corn will outlast two made from ripe brush; and the green, when cured, is worth double the red or ripe brush, and it will weigh one-third more. If housed at this stage, the stalks make excellent fodder; stock will eat it clean, and such fodder is worth several times what the seed would be; but the stalks must not be stacked like corn fodder, for they will heat and spoil. One layer of broom corn fodder and one of corn fodder in the stack will do; feed late in the fall and open spells in winter, for stock cannot eat it well when it is frozen hard. Dwarf broom corn makes the best fodder, and it produces more brush to the acre, and better brush. Pure seed is hard to get.

GRASS FOR MANURE.

Mr. M. L. Baker, Galveston Island, Texas, asked whether a layer of grass and a layer of manure built up in a pen would make good compost, and whether green or dry grass would be better.

Mr. Thomas Cavanah.—We make a good deal of manure for our own use, and also sell considerable. All manure heaps of this kind

require to be forked over every week or ten days, or they will firefang, and spoil, therefore to enclose in a pen will be worse than useless.

Mr. Jas. A. Whitney.—There is little value in grass as manure beside the mineral elements, and these are in small amount. If grass is used at all it will be better dried.

Growing Chestnut Trees.

Mr. Wm. Baker, Hillwood, Knox county, Ohio, wishes directions for planting these trees.

Mr. N. C. Meeker.—Not much has been done in planting chestnuts, as they are found difficult to transplant. The nuts must be kept moist until planted, when the ground should be planted in soil near the condition of that of the forest, by preparing a wide sandbed mixed with leaves, and they should be transplanted the next, certainly the second, year. Probably there is no more profitable fruit tree than this, and with fair management it should come into bearing as soon as an apple tree.

Rhubarb Pies in Winter.

Mr. F. K. Phœnix, Blooming Nursery, Bloomington, Ill.—Place some strong rhubarb roots in the warmest corner of the cellar, in the fall, and then let them sprout, thus having most delicious, fresh rhubarb pies during the winter.

Seeding Wheat Land.

Mr. Hugh Roberts, Gwynedd, Pa.—Having made several experiments with a view of ascertaining the proper quantity of seed, I am convinced that farmers, generally, not only waste the seed, but injure the yield of grain and grass by putting on too much seed. If the land is well manured, or otherwise in good condition, I think one and a quarter bushels of wheat sufficient. My neighbors, most of them, sow one and a half, and some two bushels. In drilling wheat, two years ago, I set the drill to put on one and a half bushels, but having finished one acre, found I had put on only one and a quarter bushels, I thought it would be too thin, but at harvest found it abundantly thick, and have been very particular since. I find three quarts of timothy enough. Most farmers here sow six to eight quarts, and so with clover seed. Corn might as well be planted two and a half feet each way with a view of doubling the crop. Some seedmen's catalogues recommend twice as much seed as is necessary.

Adjourned.

October 20, 1868.

Mr. NATHAN C. ELY, in the chair; Mr. JOHN W. CHAMBERS, Secretary.

CUT FEED.

Mr. J. W. Colbury, Springfield, Vt., writes that he has fed two horses kept for general work, on cut hay, for ten years. The hay is sprinkled mostly with corn meal, and is stirred so as to have the meal adhere, and he knows that by this means the hay will go twice as far, and that the team will do full as much work. Sometimes, if hay is scarce, bright oat straw can be substituted by adding a little more meal, or by making the feed half-and-half. In warm weather when the boxes are apt to sour, whole hay is fed and then the difference is noted.

Mr. N. C. Meeker.—I was not here when that discussion took place but was interested in reading a report of it, which was skillful and engaging. The idea I would now suggest, is that the question of cutting hay, hinges on its cost. In the west, where hay is cheap and farm labor difficult to be obtained, it will not do to manage these matters as farmers do near great cities. The money paid for a cutter and a man to use it, would buy all the hay saved in some parts of the country. The animals consumed in these commercial centers were not fattened on cut feed.

Dr. Isaac P. Trimble.—By recommending cut feed we may encourage the putting up of bad hay. I, myself, have seen of late an establishment for the preparation of cut hay on a large scale, when the quality of the hay was execrable. It could not be sold at all as long fodder, but cut up and baled it is palmed off on a credulous public.

Mr. P. T. Quinn.—Since that discussion I have talked with men who are deeply interested in knowing the cheapest and best way of feeding animals, the proprietors of these lines of horse cars, and they all tell me that no mode of treatment will compare with three feeds a day of cut hay, wet and sprinkled with corn meal. After many experiments, they have settled upon this as the cheapest for themselves, and the best for the animals.

Mr. A. Stone, Long Island.—I find it far better on my farm to cut my fodder. My animals will eat, and will *thrive* on coarse grasses and straw when cut up, which they would refuse if fed out long. I am not a doctor, and can't talk as these doctors do, about deglutition,

and silicate of potash, and the mesenteric glands, and all that, but I am perfectly certain that it pays for me to cut up the hay and straw I feed out, and all the doctors in the faculty cannot reason me out of a conviction founded on actual trials and the experience of years.

Mr. A. J. Caywood.—I am a grape culturist, and have always been a farmer and a gardener. My father was a large farmer, and kept fifty and sixty cows. He used to say that his cows always did best on pastures where they could fill themselves in two hours. The muscular exertion of walking all over a big pasture and picking all day to get their fill, cuts short the flow of milk in cows, and retards the fattening process in animals fed for the butcher. When we keep an animal for milk or flesh it won't pay to make it work for its board. I remember a story about an acute Frenchman who made an experiment in fattening squirrels. Some he fed on cracked nuts, and some with whole. Those who had to gnaw their shells open fattened slowly. Those who had nothing to do but eat the kernels took on flesh very fast. Cutting the hay for a cow is like cracking the walnuts for a squirrel.

Mr. J. B. Lyman.—I am very glad this gentleman has written his testimony on the point before us, and I hope others, and especially those who keep butter dairies, will follow his example.

Mr. N. C. Meeker.—Cows kept for milk only may be fed on cut and steamed hay, but not when butter is the object.

Mr. J. B. Lyman.—I do not consider that as proved by any means; and I hope the country members of this club, those who advance their ideas through the pen, will give us their experience. I know that Mr. Warren Leland for instance, of Westchester, who milks between forty and fifty cows, and sends an excellent quality of milk to his hotel, is a strong believer in cut and steam food. He has been convinced of the importance of treating his hay in this way, not by agricultural books, not by English practice, nor even by the wisdom of this oracular club, but by actual and frequent experiments. He cannot afford not to cut and steam. If the experience of other large feeders is contrariwise, we hope they will write us facts and conclusions.

Bone-dust and Superphosphate.

Mr. John M. Burt, Big Flats, New York, writes that he was much pleased with the paper on fertilizers, read by James A. Whitney, some weeks since, and would ask of him through the club, if such a

question is allowable, whether boiled or unboiled bones make the best manure, and whether bone-dust is as good as superphosphate.

Mr. Jas. A. Whitney.—The boiling of the bones takes away the gelatine, which is a nitrogenous substance and a quick acting manure. When boiled in lye for soap, the potash is more potent as an alkali than lime, and will take away phosphoric acid. Hence I would say that bones boiled in water are better than those boiled in lye, and those not boiled at all better than either as manure. As to the difference between bone-dust and superphosphate, it is mainly one of time, that is to say, of solubility. The effect of adding the sulphuric acid is to make the virtue of the bone effective on the first crop. Solubility is increased. Bones are very slow in dissolving; but when ground fine the acids of the soil and water are much more active upon them, and bone meal will show itself on the first crop.

Mr. A. S. Fuller.—I have bought and used as much bone manure as any man in New Jersey, and I greatly prefer the bone ground fine. In truth I have never seen any benefit at all from the use of superphosphate. The last I bought I was so disgusted with that I dug a big hole and buried the whole of it to get it out of the way.

Mr. P. T. Quinn.—Mr. Chairman, our friend Fuller does make such sweeping statements that I cannot let this last remark of his go out without a word of comment. He says he gets no good at all from superphosphate. Now, I have used it all my life; in fact, as he suggests, I was raised in a superphosphate factory; and if this club will take the matter in hand and make a close investigation, I will open my farm and he shall open his, and I will agree to show just as good trees, crops, plants of all kinds, raised by the use of superphosphate, as he can show from using bone-dust. Both are good manures, yet some years neither of them will show much effect. But, though bone-dust has sometimes disappointed me, I would try it ten years before I would make so rash a statement as he makes to-day. We know the sulphuric acid can do no harm when poured over crushed bone. I find it pays to use it. With me the cost of the manure is a matter of no importance; it is the outlay as compared with the income from it. For instance, I have just taken $600 worth of cabbage from an acre, the field was seven acres. What do I care if the manure on that field cost me over $1,000. Do not I get it back three times over in my returns? The manure I use is blood compost and superphosphate. With me it pays.

Mr. N. C. Meeker.—Last year I spent about fifteen dollars in super-

phosphate, and came to the conclusion that I should have come much nearer getting my money's worth by buying stable manure.

Mr. A. S. Fuller.—Now, gentlemen, you may go to the great nurserymen and market gardeners, the successful men, those who get rich at it, and ask them about manures. What do they say? Peter Henderson uses barn-yard manure, and pays six or seven dollars a load for it rather than not get it. Elwanger & Barry, the leading nurserymen of Rochester, I may say of America, use the dung and litter of animals; none of your chemicals and phosphates for them; it is the dung-heaps they believe in. The farmers would be better off if they would pitch these sham fertilizers into North river.

Mr. H. T. Williams.—After numerous experiments I have come to the conclusion that I can bring my land into the condition I want it for any crops with swamp muck, ground bones and fish guano.

Mr. James A. Whitney.—Gentlemen speak in a confident and sweeping way, without adding a word of explanation as to the crop for which they fertilize. These men, cited with such flourish of authority by Mr. Fuller, are small fruit culturists. They do not raise wheat, nor roots for stock. They require a light, active fertilizer that will act promptly. When we cultivate for stalk we need one kind of manure, when we seek returns of seed or grain we should use another kind of fertilizer. The best top-dressing for grass is not the most suitable application for wheat. For grain we should use substances that contain phosphate of lime. In fruits we care little or nothing for the seed. In wheat the grain is everything. The practice of special cultivators and market gardeners will not do as a guide for all farmers.

Dr. Isaac P. Trimble.—Ah, gentlemen, you would not be wrangling here over the phosphates if you could get plenty of our Jersey marl.

Mr. P. T. Quinn.—I have seen the effects of Jersey marl, and I have bought and used it. Just like every other manure, it depends on soil and the crops to be raised. Its effects on the sandy lands of south Jersey are indeed wonderful, but on my heavy red clay, I would not give ten cents a ton for it.

Mr. A. Stone.—With us the conclusion is general that when we come to buying manure, the best investment we can make is in bones ground to a fine dust.

The Walter Grape.

Mr. A. J. Caywood brought before the club numerous clusters of this new hybrid. He wished to say a word with regard to a com-

plaint published in the *Sun* by Mr. Fuller, that he had locked up the Walter in a glass case for fear people would steal it. He thought the stricture uncalled for, and unworthy a gentleman who had made some reputation for himself as a small fruit culturist. He had been for many years laboring to produce a superior grape, and at last had the pleasure of seeing a six year old vine of the Walter loaded with sixty of the most beautiful and luscious clusters. Those clusters he had been careful of, and they had taken prizes or awards at seven different fairs, in every class of which the grape had been entered. He could now offer to Mr. Fuller and other members of the club one of these clusters.

Mr. A. S. Fuller.—I think very highly of the Walter; it has merit and great promise. But how can we say it will do well on all soils until it has been tried on a variety of soils. What we *know* is that the fruit of the vine in Mr. Caywood's yard is very excellent. I cannot believe that Mr. Downing and others, if they had a vine of such merit, would damage the originator by allowing persons to propagate from it with cuttings. I am no enemy to the Walter, on the contrary, I habitually speak well of it, and believe it has a rich future before it.

Wm. S. Carpenter Grape—Prunes.

Mr. Daniel Thompson, Green Island, opposite Troy, showed several varieties of seedlings, among which was what he claimed as the Delaware, which he has had growing many years, and which he called a foreign grape. A fine grape was also exhibited which he has named the Wm. S. Carpenter, or out-door Hamburg; the bunch of this variety is open, and is of great promise. He also showed a plate of prunes, which he says do well on his grounds, and that they are most successfully grown from the seed. Whether this fruit can be grown in this country with as sprightly a taste as in Germany is uncertain.

Report on Tobacco Soap.

The following was read and approved by the club:

The undersigned, appointed a committee to consider and report upon the merits of the compound termed "Sapo Tobacum," or tobacco soap, to which the attention of the club was recently called by the Tobacco Soap Company of Clifton, N. Y., respectfully ask leave to report:

That inasmuch as whale oil soap has long been known as an efficient agent for the destruction of insects, and a solution of tobacco is equally noted for its efficacy for the same purpose, your committee believe that the tobacco soap will prove an excellent preventive against the ravages of insects upon plants or animals in all cases where its cost does not preclude its use on the score of economy.

Your committee, however, would utter a decided protest against the too common practice of claiming for articles properties and merits which they do not possess, an instance of which is found in the communication referred to your committee of the above mentioned manufacturers with reference to the "Sapo Tobacum," in which they claim that this material is "an invigorator, a fertilizer," and that it "gives life to the sap." It is simply impossible for any compound applied to the bark or leaves of a plant to act in either of these capacities; and any claim of the character indicated is reprehensible, as tending to not only mislead the public as to the intrinsic value of the substance, but also from its tendency to inculcate error with regard to the functions and applications of manures, and kindred matters connected with agricultural science.

Respectfully submitted.

JAMES A. WHITNEY,
LOUIS FEUCHTWANGER,
Committee.

Concrete Walls.

Mr. G. T. Coe, Toolsboro, Iowa.—Good concrete walls may be made by slaking good lime and clean sharp sand; mix so that the mortar will barely slip off a polished hoe when you lift it full; then add as much clean gravel as can be mixed in; then put in strong molds and beat down with a flat ended maul, when some mortar will rise to the top, which must be filled with gravel, and so on. No two kilns of lime are exactly of the same strength, and sand is so different, no certain proportion of sand and lime will do everywhere. The only true way is to test the mortar with a polished hoe; if it sticks to the hoe when just soft enough to plaster with, it is too strong of lime; if it slips off very easily, not strong enough. Molds should be made of one and a half inch plank, and frequently supported by bolts, so as not to spring when pounding down the concrete. Now this pounding down is the main thing.

Adjourned.

October 27, 1868.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

LAMENESS IN HORSES.

Mr. W. Honneywell, Dallas, Luzerne county, Pa., inquires for a remedy for what he calls "stocks" in the hind leg of a horse, which seems to be a swelling noticeable after the animal stands more than twenty-four hours.

Dr. J. E. Snodgrass.—A bandage, applied surgical fashion, would be a great help; that is, tight lacing, and this is the only case in which this practice is to be recommended.

Dr. J. V. C. Smith.—In all such general cases friction is a good remedy, but I would in particular recommend electricity. It is singular that its application has not been made to horses, for it has great remedial powers. Horses are much abused, and too little thought is bestowed upon their management, particularly when borrowed.

A. W. Lozier, M. D.—I had a horse some years ago which was accidentally pricked with a fork in the gambrel joint, letting out the synovial fluid or fluid of the joint; in consequence of which it became enormously swollen and stiff. Several veterinary surgeons pronounced his case hopeless, and recommended as a mercy to the animal to open a vein and let him go, as his suffering was extreme, and he was soon reduced to a skeleton. But being attached to the creature, I at last found a veterinary surgeon who promised to do something for him. The horse was kept in slings for nearly a month, and after dashing water upon it, packings, liniment, fomentations, &c., with but little avail, I concluded from what I had seen in the practice of medicine to try electricity, and had it tried twice a day regularly. The swelling began to go down at once, heat and pain subsided, and it was really amusing to see the horse hold out his wounded joint toward the surgeon every time he came with his battery. In two or three months he was as well and valuable as ever, with no trace of lameness or swelling whatever, and continued so. The electricity was applied for ten minutes twice a day, by means of a simple hand battery.

GROWING TIMBER.

Mr. David Pettit, Salem, N. J.—Mr. Lyman says that from conversation with farmers he has set down the average duration of fence

rails as twenty years. This may be, and is undoubtedly true of oak and some other kinds of rail timber, but good cedar and chestnut rails, if barked in season, will last until they wear out with use, or from fifty to 100 years or more. There is in our flat agricultural county at least one-fifth of the land not well adapted to farming purposes, and in hilly countries a much greater proportion, owing to various causes; but it is much better adapted to the growth of valuable timber, and would be more remunerative in the end at the present prices of lumber, if properly planted with valuable forest trees, and cultivated a few years where practicable, until the young timber can get a start and so take care of itself. Our friend Lyman selects the locust, rock maple, black walnut, European larch, and, especially on rocky lands, the locust and rough bark hickory as the best and most valuable. In planting trees for timber especial regard should be had to the rapidity of growth of the tree, the value of the tree when grown for fencing, building, and other purposes, and its durability when exposed to the weather. Locust wood is heavy and very durable, and the trees are of rapid growth when young, but are liable to be attacked with borers in the body and limbs, so that many of the young trees fail; where they do succeed it requires an age to grow to a size for building purposes, and besides they never grow to make large timber. The black walnut is healthy and grows to a large size, but not in an ordinary lifetime; is about as heavy as the chestnut, is porous, and much more sappy, consequently that part is not durable when exposed to the weather. I knew a tree that was cut down in 1822, and the heart of the stump remains perfectly sound yet; being forty-six years. The wood of the European larch may be very durable, and has been highly recommended, especially by nurserymen having the young trees for sale. The tree grows straight, tall, and very rapidly while young, but will require an age to make timber of much size; and the wood when grown is very light. The shellbark hickory will require a much longer time to grow and the wood is very valuable for carriage building and other purposes, and the nuts command a good price in the market; but the wood is not durable unless seasoned and kept dry. I have no doubt but the profit of growing the best forest timber on indifferent land will much more than equal that of any farm crops grown on such land, if properly planted and taken care of a few years; but the length of time it will require to get returns for the loss of land, cost of planting and cultivating, will deter some from embarking in the enterprise, especially those with small means. Although our

friend Lyman classes the chestnut among those the least valuable, I class it among those most valuable in our section of country, and as such will offer you an estimate of the profit of growing an acre of chestnut timber. I will suppose the trees planted one rod apart each way, making 100 trees to the acre, to cost at two years old in the nursery five dollars per hundred, or eight dollars per acre; add to this two dollars for transplanting, and we have ten dollars per acre. If planted out younger they will not succeed so well, and if kept longer in the nursery the risk of dying will increase with the time. The chestnuts should be kept damp as soon as ripe to insure success, as a very few days exposure to the dry air will prevent germination. If the land is fit for tillage it can be planted with corn or some other cultivated crop, four feet one and a half inches each way, and at every fourth hill, each way, plant the young trees and cultivate with the crops, which will facilitate their growth, while the crops will pay; then leave them to natural causes for protection. When the land is too hilly or not fit for tillage the trees can be set without the expense of cultivating. In about eight years after transplanting, the trees will become bushy and not fit for rails and should be cut down to eight or ten inches from the ground. If they succeed well they will send up at least five good suckers from each stump. These will grow rapidly, straight and tall, and will in twenty-five years, or less, from planting make six good rails from each sucker or 4,800 rails per acre; which, at nine dollars per hundred, amounts to $432, or sixteen dollars a year clear of cost of planting. After this cutting they will become more remunerative as they will bear cutting every fifteen years and produce more at each cutting, or at least twenty-six dollars a year, and this, too, without the expense of fencing, or farming, or cutting the timber, as the tops and branches of the trees will amply pay all expenses. If the above estimate is correct, where is there any farm land that will equal it in profit of farm crops for a series of years? If the estimate is considered too high, reduce it one-fourth or one-half, then add seed, labor, manure, and the cost of fencing, to say nothing of the extra taxes on the improved land, and then we shall see which will pay best. Sixteen dollars a year is the interest on more than $200 per acre, and twenty-six dollars for the second cutting, the interest on more than $350, more than our best land will sell for near markets. I know of young chestnut trees where the timber was cut not twenty-three years ago, that will make more than double the above estimate of rails, and some will

now make good building timber and fence posts. The American tulip tree grows very large and about as rapidly as the chestnut, but the wood is not durable when exposed to the weather. Other valuable timber will require a much longer time to grow.

Mr. J. B. Lyman.—I am glad that farmers are turning their attention to this subject. In speaking as I did of the value of rough-bark hickory, I was aware, as Mr. Pettit suggests, that it does not last when exposed to the weather, but, on account of its great toughness and value for machinery, I recommended the planting of walnut trees. The consumption of tough wood for wheels, axles, levers, &c., is very great and increasing. On this account, I cannot but think farmers will do well to spare all young white oaks and ash and hickory trees, and to plant them in soils adapted to their growth. With regard to the average duration of fence rails, I obtained the information Mr. Pettit speaks of by asking a great many farmers in different States how long their rails last. The average of the periods thus mentioned was found to be from fifteen to twenty years. My object in bringing out the information collected in those papers, was to induce farmers and railroad men to use some preserving process in timber exposed, and to take means to keep up the supply of valuable wood.

Mr. A. S. Fuller.—At length after a provoking lethargy, I rejoice to see a waking up to the importance of forest tree culture. Years ago I wrote a book on the subject. Nobody said much about it, and few would read it. In this club, nearly ten years since, I read a paper on the subject. It fell on a drowsy public ear. Now people are waking up, and I am glad. Why, I can make as much money by planting locust as I can by planting corn; just as much, acre for acre.

Dr. Snodgrass.—In addition to the list of trees suggested by Mr. Lyman, I beg leave to name the ailanthus. True, the smell is not agreeable, but it grows very fast, and the wood is as valuable for many uses as black walnut or maple. It burns well, and I have found it quite useful for kindling wood.

Models of Animals and Plants.

The Chairman then introduced Dr. F. G. Lemercier, a French scientific gentleman. Upon a table, and on a pyramidal support were presented to the audience a great variety of clastic models, or preparations, representing various natural objects, among which were the anatomy of the horse, composed of apparently solid pieces, but which are readily separated into many pieces, each of which shows some impor-

tant internal structure. Also models of insects, vegetables and fruit, prepared by Dr. Auzoux, of Paris, assisted by Dr. Lemercier. This last gentleman showed first the foot of the horse, remarking that this is the most important part of the whole animal. If there is no foot there is no horse. It is necessary to understand the structure of the hoof in order to understand the nature and value of the horse. Almost always the fore feet are largest, though in Russia the speaker had seen some horses with hind feet of equal size; but such animals cannot bear heavy weights, and they are more fitted for jumping. There are three bones in the foot which correspond to the three joints of a finger, and the hoof is the nail. A good horse should not have a flat hoof, and the shoe should conform to the natural form of the hoof. It is the practice with smiths who do not make shoes of the right form to pare off the hoof, which should not be done except at the point corresponding to cutting the nail, otherwise the hoof is easily broken, and the interior tender tissues injured; the model which the doctor exhibited. The nails should be so driven as to preserve the elasticity. The reason why we must conform to what nature has established is because her ways are best. The doctor then showed a full sized leg with incipient spavin, then other models with aggravated forms, and others in various stages, all of the most marvellous mechanism, and colored as in nature. Next were exhibited representations of flowers, fruit and grain, composed of many parts, which were detached one after another. An analytic exhibition of a grain of wheat was quite appropriate. In speaking of the gluten he said it is an important element in the formation of bread, and that when we separate it from the starch we take away what corresponds to beaf steak in food.

There were many other objects in this collection which time did not permit him to explain, but the following is a list: A silk-worm, two feet long, containing the complete anatomy; a viper's head, and the body of the American turkey; the uteri of two domestic animals in three conditions; the snail; the May bug, in thirty parts, and 600 minutiæ; the queen bee, drone, and worker, in their various occupations and relations, and the honey comb in various stages of construction, including the germs of the bees in their cells; a hen's egg, in several parts; the stomach of the cow, with the four parts; the stomachs of graminivorous birds, in various conditions, according to the food received; the stomach of the horse, illustrating why this animal cannot vomit; also the model of the horse complete, and of course including many complications. Of the grass pink there are fifteen

parts; the morning-glory the same; flower of peas with the polen, germs of the seed, and the seed in several stages; the chrysanthemum, the jessamine, the fuchsia belladonna; acorn of oak, showing the various tissues and the progress of growth, with illustrations, showing the circulation of the sap, and the formation of the wood and bark; the cherry, with its distinct layers, the strawberry, mulberry, male and female flowers of the muskmelon, flower of moss, and the different kinds of mushroom, showing which are poisonous and which are not. Such objects as are small are magnified many times, so as easily to be seen and understood. The material of which these preparations is composed is papier mache and other substances, faithfully colored and marked, and they are most wonderful models of scientific anatomical mechanism.

His remarks were frequently applauded, and the hearty thanks of the club were moved by

Dr. J. V. C. Smith, who said: Mr. Chairman, this exhibition has certainly been very instructive; we see how much solid and valuable information can be conveyed by the eye. This mode of imparting truth is so vivid and impressive! Who of us will soon forget the wonderful structure of the hoof of that noble animal whom we so much use and so much abuse? How deep the conviction must be fixed that we waste the best part of the wheaten grain. What supports the 9,000 dentists that thrive in our community? Mr. Chairman, the bolts of our flouring mills make the race of dentists necessary. Our children do not have in their bread the material for making bone and enamel. We of the cities are smaller than the bony frames built up in the country. Why? Because there is not bone food in the substances we eat. Our food is quite too concentrated, not gluten and silex enough, too much starch and sugar. If Dr. Lemercier can by his lectures convince us of our national mistake, he will be doing us a great public service. Dr. Smith concluded by moving a vote of thanks to Dr. Lemercier.

Mr. James A. Whitney.—In seconding the motion of Dr. Smith, which I do most heartily, I wish to signify my high valuation of such exhibitions as our learned friend from Paris has just made. A thousand merely oral descriptions could never have made so clear an impression of the importance of having our horses shod properly. Hours of harangue upon the value of graham bread could not have done so much to persuade us as this admirable dissection of a grain of wheat. Time has been when the link that bound America to her ancient and

honorable ally was one of political interest and sympathy. Now France and the United States are united by the warmth of intellectual sympathy and the tie of a common interest in some of the most important investigations that affect the weal of mankind.

The motion of Dr. Smith, was unanimously carried.

THE NUTTING PATENT WHEEL PLOW.

The committee appointed by the club to witness the practical operation of this invention, submit the following report: The plow itself has nothing peculiar in its construction. The point of the invention is an apparatus consisting of an axle connecting two wheels of unequal diameter (because one must run in the furrow) and having levers and poles arranged so as to raise, depress, and otherwise regulate a plow hung beneath. There is a seat for the driver; the machine we saw was intended for two horses; but a smaller plow could easily be drawn by a single horse. Suspending the plow in this manner, we find to be a clear and very important advantage in working land not containing stumps and fast rocks. By means of the lever the plow can be raised, while in motion, to ride over obstacles. We are of opinion, from what we saw at the trials, that more than three acres of light soil can be turned in a day with greater ease to the team than two acres in the usual way. A plow is essentially a wedge, and the friction of the lower surface on the furrow bed is measured by the depth and weight of the furrow slice turned. Now suspend the plow and this friction is taken off. The plow is no longer a wedge between the furrow bed and the furrow, but a hook, carried over the surface, and held so as to take up and turn the furrow slice. The precise difference is this; the friction is taken from one-half of the touching surface when the plow is in action, and transferred to the axle, where the surface is polished and oiled. Thus, the friction is reduced, we think, about one-third. With regard to this particular device, a few improvements might be introduced, which would lower its cost; and here your committee would suggest to agricultural inventors that when an improvement so fundamental and important as this, a device by which thirty acres can be plowed with the same power that is now expended on twenty acres, is proposed, a regard for the public good, as well as a wise self-interest, dictates a management by which such implement can be made as cheaply as possible. For instance, the patentee might sell the gearing that attaches the plow to the axle for

ten or fifteen dollars, the farmer supplying his own wheels and axles. As to the principle of suspending the plow between wheels, we are satisfied that it is sound, and a great saving of power, in precisely that department of farm labor where the economizing of brute muscle is of the utmost importance. On Wednesday, the 14th inst., we went to Harlem and saw the plow tried on a stiff old sod, and also on a mellow, soft garden soil, free from stones, selected by the patentee. It worked admirably. But your committee thought that, in order to give it a full trial, it should be used upon a heavy soil. On the following Saturday a second trial took place, on a farm near Rahway, before a number of practical farmers. One acre was measured. The sod lay on a heavy clay soil, being a mixture of clay, loam, and red shale disintegrated, and mixed with stones of various sizes. Half an acre was allotted to Mr. H. Moore, the manufacturer of the plow. He geared it to plow a furrow seven to eight inches deep, by twelve to fifteen inches wide, which was two inches deeper than it had ever been plowed. Fast stones were met with at intervals. The plow detached some and rode over others. The other half-acre was assigned to a stout German, who did his best to beat the sulky plow, only making a furrow six inches deep and ten inches wide. Mr. Moore accomplished his task in two hours and a half; while it would have taken the other man fully an hour longer to plow his share. During this last trial, four of the farmers present rode the wheel-plow; two of them were over sixty years of age. The first one, after plowing two furrows, exclaimed that it was a blessing for old farmers like himself! and that with this new improvement he would be able to farm for ten years longer, as by its aid he would save about a hundred miles of walking that he had to do in plowing his ten-acre plot every year. All present were of the same opinion. This plow can be used by one-legged returned soldiers, or by any lady without the necessity of their adopting the bloomer costume.

ADOLPHE PRETERRE,
JOSEPH B. LYMAN,
Committee.

Lozier's Hay-loading Apparatus.

The committee appointed to examine this invention made the following report:

The machine was invented by Dr. A. W. Lozier, of New York city, and is intended to elevate hay from the cock or window, or stooks of

unhusked corn on the wagon or cart. A light and easily adjustable arm is hung to an upright standard, fixed on the wagon or rigging in such a manner that it will swing itself rapidly to the center of the top of the load when operated. A rope slings over a pulley attached to the upper end of the arm, to one end of which is hung a light, steel self-locking and tripping claw-fork. There are as many wrist-pins as there are spokes in the wheel.

The fork is thrust into the cock or mass of hay, which may weigh from seventy-five to two hundred pounds, and the team is started forward; the rope engages with each pin successively as the wheel turns, thus elevating the hay above the shelving, when, by pulling a trip, the arm swings in the hay, and the fork quickly delivers it on the load. The hay in this instance was taken from the barn dry and broken. The fork loaded it quite clean.

In loading corn, a rope is hooked around the stook, and by a simple device the corn, when raised, is instantly tripped on the desired point on the load. Cocks of hay from twelve to forty feet, or even more, may be loaded, the team stopping but once to each or taking it up as it passes. The machine loads as well on the sidehill as on the level, and can be adjusted in a short time to any wagon wheel and rigging. It is simple, not likely to get out of order, and so easily manipulated that a boy works it, while a man, mounted on the load, drives the team and places the hay. When driving into a barn the arm is readily dropped. The machine will load, with all ease, in from twelve to fifteen minutes, and the committee report it a great labor as well as a time-saving machine, much needed by our farmers.

The probable cost of the machine, when manufactured, will be about thirty dollars.

The committee also witnessed the operation of a light and strong horse hayfork invented by Dr. Lozier in connection with the former apparatus. The fork is simple and powerful, locking itself when thrust in the top of the load, and taking the hay grasped flush up to the pulley at the center peak of the barn, then transferring it without the horse stopping, along a traversing rope suspended from the ridge-pole to the farthest side of the mow if desired. The fork has three steel curved tines, has no projecting handle or trip in the way while elevating, and carries the hay clear over the great beam of the barn without material sagging. The traversing rope saves the expense of a built car track, and with its accompanying guy-rope and device, is a very cheap contrivance for enabling the farmer to

unload centrally without dragging off the hay from either side of the wagon while doing so.

S. EDWARDS TODD,
WM. S. CARPENTER,
JONATHAN CAMP,
Committee.

USE OF LIME.

Mr. Wm. Brinkworth, Hanover township, Jefferson county, Ind.—I wish to tell you my experience. First, I commenced burning lime about thirteen months ago. Limestone of a very superior quality is abundant here. The wood ashes and air-slaked, or refuse lime are used on my land with very satisfactory results, my corn crop being about double this season to what it was last, and other produce in proportion. The potato bug made its appearance early in the season. I took air-slaked lime in a peck measure, and with a trowel scattered it broadcast over the potatoes. The next day not a bug was to be seen. Two weeks later they appeared again in spots where the lime did not reach. I repeated the experiment with like results. Later they appeared again and again. I gave them lime, and my vines kept green until frost came, while some of my neighbors' vines were stripped and ruined early in the season. My crop is better where the lime was put than in other parts of the field where it was not cast, thus showing it did good two ways. My lime is very strong, and commands a ready sale, mostly at Madison, seven miles distant. Every farmer should burn and use it if he has the stone; mine is full of fossil remains, very pleasing to look at, both before and after it is burned. One of my horses was cured of the heaves and a cough by eating corn twice out of the wagon the lime was hauled in. I now put some in all the mangers once a month.

CRANBERRIES.

A crate of this fruit grown by J. G. Torrey, jr., Manchester, N. Y., was exhibited to the club. Mr. Greeley pronounced them the largest, handsomest, finest, and every way best cranberries he had ever seen. Mr. Torrey has seven acres, which this year will yield about 750 bushels; at the same time other fields have very short crops owing in many instances to the ravages of grasshoppers. One reason for his success seems to lie in covering the vines where they run over each other and cannot reach the soil, with two or three inches of sharp sand, which seems a method worthy of note.

NEW WEEDING HOE.

E. M. Conkling, Panama, N. Y.—In working, this lies flat on the ground; it is arrow-shaped and has cutting edges on three sides by which weeds are cut both in a backward or forward motion, while there is an elevated pointed edge rising in the center helping to separate the soil, something like a colter. Such a hoe ought to do most effective garden work.

Adjourned.

November 10, 1868.

MR. NATHAN C. ELY in the chair; MR. JOHN W. CHAMBERS, Secretary.

FARMING IN SALEM, NEW JERSEY.—DEEP PLOWING.

Dr. Trimble, as chairman of a committee, read a paper on farming in Salem county, New Jersey; and to illustrate the subject he presented most wonderful ears of corn, which grew in that region. One specimen was the result of twenty years' experiments by David Pettit. Originally it was short and thick, but by culture and selection it has now become long also, with from twenty-eight to thirty-two rows, and often with 2,000 grains to the ear.

Mr. Chairman.—It will be remembered that *deep plowing* has been frequently urged by members of this club. One gentleman who often honors us with his presence, and who has world-wide fame as one of the most profound thinkers and the ablest journalist of the age, has, on several occasions, been very strenuous on this point; so much so that practical farmers, whose experience has taught them to take different views on this subject, have been fearful that such teachings might lead the unexperienced to try a system of plowing, not only laborious and expensive, but which, on many soils, would prove quite injurious. One such farmer, David Pettit, of Salem county, N. J., who lives in the midst of a large community of the most intelligent, pains-taking and successful farmers of our whole country, sent us a communication so boldly controverting this theory and supporting the contrary view by so much experience of himself and neighbors, that a committee was appointed to visit that section and report as to the truth of his communication. That committee made the visit to Salem county soon after its appointment, but have delayed reporting till now, so as to be better able to judge of crops not then matured. In all this trip we found but one farmer who was in the habit of

plowing as deep as six inches, some five, most four, but a few only three or even two and a half inches. The hay crop generally reported at two and a half tons to the acre, while the wheat was often so rank in straw as to lodge. In such cases the grain is more or less imperfect, and the general report was about an average crop of wheat, or rather less than such a large crop of straw would indicate. The weather in the spring and early summer had been wet and cold, as with us; but for six weeks previous to our visit there had been almost no rain in that immediate neighborhood.

This is difficult to understand when we remember how all other sections were flooded throughout the past season. The drouth continued six weeks after our visit, there not being two inches of rain during twelve weeks, upon the farms we visited. We traveled over a district of country in Mannington, well cultivated, for a distance of seven miles, to a field of corn of about thirty acres, planted on a sod, on a farm of Dr. Dickinson, worked by his tenant, Mr. Dubois, said to have been, and we believe was, upon examination, plowed in the spring only three inches deep. The corn was of a good size for the season (30th of July), mostly from eight to ten feet high, the tassels beginning to show generally over the field; will be, when full grown, from ten to twelve feet; some was in silk. The drouth and heat at this time was extreme, but the corn blades were not curled or rolling, but remained green down to the roots, and had not suffered any apparently from the dry weather, while a clover field adjoining, of the second crop, was suffering severely. We examined the soil and found unmistakable proof that a very large portion of the roots, certainly nine-tenths of them, were imbedded in the sod within three inches of the surface, while but a small part were found below; some were found as low as twelve inches, thus showing conclusively that in a dry time a large portion of the roots, forming a complete network, were imbedded in the sod near the surface, to seize upon the fertilizers in the soil, and in the small rains and dews, from the atmosphere, and the moisture brought up from below by the heated surface of the ground for the support of the plants, and thereby prevented evaporation. We observed the sod had been turned up in plowing the corn. This was thought to be not good policy by the farmers accompanying us, as it exposed the sod more to the sun and increased evaporation. Experience teaches them the ground should be plowed deep enough in the spring to give a mellow surface above the sod to work in while tending the crop. A depth of four or five

inches will enable them to do this. If the feeding roots of corn run near the surface of the ground in a dry time, there can be no doubt but they seek food and moisture there in a wet time.

We visited next the farm of Allen Wallace, four miles northward, in Pilesgrove, near Woodstown. His corn was good and green down to the roots, with but little rolling. He informed us he began thirty-five years ago, with raising only seven bushels of sound corn per acre, or less than 200 bushels on thirty acres. The next year ten per acre, and by 1840 he had increased his crop from less than 200 to 600 or 700 bushels. The farm was then divided, he retaining one-third, and he has since raised much more on that third than he did before the division on all. His corn crop has been, for the last fifteen or twenty years past, from two and a half to four loads of ears per acre, according to the season, of twenty-five bushels shelled corn each. He gave it as his experience that he succeeds better by plowing rather under than over five inches deep, having tried both. His improvements have been made with marl applied to the surface once in five years principally, and with liming moderately and applying the manure made on the farm, in connection with good farming.

We then passed through the farm of Aaron Lippencott, another successful farmer, who has raised his land from a low state of cultivation to the highest productiveness, and of whom it has been said, after he gathered his grass crop, there was more left than the former occupant ever raised on the same ground. On his farm last year your committee saw a field of corn of most magnificent growth, and on the same field this year the best field of stalk-ground corn we have seen. He says he never succeeded well with corn until his hired man plowed a field for corn only four inches deep, from which he gathered his first good crop of corn; he says he does not want land plowed more than four inches deep for him. Your committee learned that Josiah Engle, near Sharpstown, had part of a field of stiff sod plowed very shallow for corn while he was from home. On his return he feared when dry weather came on, it would burn or dry up. But when dry weather did set in after the middle of summer, it remained green and flourishing, while in much that was plowed deeper the corn rolled badly. His was not plowed three inches deep, and they had to scrape up the grass roots to get dirt to cover the corn. We traveled over another district of highly cultivated country, five miles, to Elisha Bassett's. Here we found the best field of corn in our travels. This farm is in a very high state of cultivation. Is a successful farmer; has had 700

bushels of potatoes on two acres; had, one year, 200 bushels on banked meadow, which were sold for one dollar and fifty cents per bushel, amounting to $300 per acre. Plows about five inches deep. The greatest difficulty with him now in raising a wheat crop is to get it to stand up so as to fill.

We next went four miles, to the farm of George Abbott, near Salem, and visited with him his banked meadow, now in herds grass. He had just finished mowing fifty acres of this herds grass, producing from two to two and a half tons per acre. He had some of his banked meadow planted with potatoes, the vines looking most luxuriantly. These were not affected by the drouth. Owing to the large crops of grass cut and foddered on his farm for more than fifty years past, he plows six inches and raises good crops. The reason he gave us for plowing so deep as six inches was to make room for manure. He does not want tide meadow plowed more than two or three inches deep, just enough to cover the sod; by so doing he succeeds best, although the rich deposit is several feet deep. These tide meadows, when dry, produced the heaviest crops of corn and potatoes, and with lime only, heavy wheat. C. Harmer, of Lower Penn's Neck, gathered from ten acres, only limed, 370 bushels of wheat. It is difficult to lime this tide meadow so heavy as to injure it. W. G. Woodnutt applied 1,000 bushels slaked lime to one-third of an acre, with the view of mixing with the soil for compost, but was induced to plant it with corn, and the result in the large growth of corn was astonishing. The account was published with the proceedings of the farmers' club of Salem county. Green sand marl of the West Jersey Marl Company, and other marls of the same strata and composition, applied to the surface of poor land, on young clover, ten tons to the acre, early in the spring, with a moderately wet season, sometimes causes such a wonderful growth of clover, that it falls long before mowing time.

On viewing the appearance of the growing crops in Salem county during our late visit there, and during the spell of protracted dry weather then existing, we can say that we know of no section of country under any system of culture where the growing crop would be more flourishing under like circumstances than that witnessed by us when there. And we believe from what we saw, and from corroborating evidence of others, that this land, plowed five inches deep, *or under*, will withstand the dry weather quite as effectually as that plowed deeper. The reason is, all soils contain certain amounts of

fertilizing matter, and the more these fertilizers, this vegetable matter is kept together, the richer the soil must be; and as vegetable mold is the best material to retain moisture or retard evaporation, and as it is proven that the feeders of all plants run near the surface, therefore, the more this vegetable mold is contracted and kept near the surface, the better it will withstand dry weather and supply food to the plants.

All soils are considered as originally merely disintegrated rock, and exclusively mineral, or a mineral basis in combination with oxygen. All plants have more or less of mineral constituents. Silex, or sand, is a necessity in the maturing or strengthening of the straw of wheat. Lime will often double the crops of oats or peas. But no land would pay for cultivation that was exclusively mineral. It must contain humus, or vegetable mold, and the more the better, provided there are also the minute portions of mineral ingredients that plants require. This humus is the residuum of decaying plants since the creation; and, judging from the depth of the soil as found in primitive forests, some kinds of mineral soils are better than others. Where all is land we find stunted pines, and the humus or leaf mold is but a mere crust. In districts where the timber is heavy the soil will be five or six inches in depth. The depth of the virgin soil in that portion of Salem county we saw is generally from three to four inches. By good farming and free use of fertilizers that soil has been made to produce seventy, eighty, and even 100 bushels of shelled corn to the acre, without plowing deeper than this native soil. Your committee will not say that the limit of productiveness in Salem county has been reached; that would be a hazardous assertion. But where we see a whole neighborhood of such intelligent farmers producing such superb crops by shallow plowing, and the most of them lessening the depth by increased experience, we feel that we may cite their example as a caution against the indiscriminate adoption of a deep system of tillage. A part of your committee subsequently visited portions of Delaware and Chester counties, in Pennsylvania. We saw many of the celebrated grazing farms of the Brandywine hills. In Salem the staple crop was corn, and that crop had then increased just in proportion as they had diminished the depth of plowing. Upon the Brandywine farms the staple was beef, and the best pasture fields there were those that had never been plowed at all. It is what is usually called the soil that is to produce the crop. Take that off, as is sometimes done in making basin or

roads, and whether you plow deep or shallow, your crops will not be worth the planting till you make another soil. In the best portions of New Jersey and Pennsylvania through which we traveled, the natural soil of the uplands (and we are not considering alluvial formation in this connection) was generally from three to four inches in depth, as shown by the banks along the roads ; in some concave spots, where leaves had accumulated during the ages of forests, we may sometimes see a depth of five or six inches.

This is the primitive or virgin soil. It is dark colored ; the line of demarcation between it and the subsoil is usually distinct. It is the decayed vegetable matter it contains that in a great measure makes it productive. Now suppose you use a plow running a foot deep, your three or four inches of soil will be covered with eight or nine inches of subsoil. The farmer who can prove that such plowing is best, must prove also that the feeding roots of plants prefer to burrow down to such a depth. Dr. Thompson, of Salem, told us he wished to make his garden more productive, and had one-half of it trenched. That portion, for the time being, he considers ruined. Sweet corn produced little, spindling stalks, and absolutely no ears. He says there is nothing to be done now, except to manure, and manure until he makes all the worthless ground he has brought to the surface as rich as that he buried. If you have a superabundance of manure do as George Abbott does, plow deeper, so as to make room for it. If you want great crops of corn, do as they do in Salem, have nothing grow upon the ground but corn at the same time ; no weeds, no grass ; cultivate, and cultivate the surface, whether the season is wet or dry, but more often when dry. As to the hospitality with which we were treated, and the proofs of high civilization that we saw during the trip, we have only to remark, that whenever it shall become necessary to send another committee to Salem each one of us wishes to be considered as a candidate for appointment.

I. P. TRIMBLE.
A. B. CRANDALL.
J. C. V. SMITH.
T. C. PETERS.
J. B. LYMAN.

J. B. Lyman.—Mr. Chairman : Although I sign this report, and approve it as a statement of what I saw, I wish to express a dissent from some of the conclusions drawn by Dr. Trimble. He has omitted to tell the club the character of the subsoil, and the whole ques-

tion of deep and shallow tillageing hinges on the character of the subsoil. I have brought from the very field to which he refers, the forty acre cornfield plowed three inches deep, this pot of subsoil, dug at a depth of twelve or fourteen inches. To compare with it I have brought a pot of subsoil from the Mapes farm, that has been subsoiled for years, with what good effects Mr. Quinn can best tell. Now I desire the club to examine these contrasted earths; the whole question is one of subsoil. The earth from Salem county is, as you see, a light, porus clay loam of fine texture, and apparently rich in some of the elements of plant food. This character of subsoil extends over an area about thirty miles long by ten wide. Now, the tillage suitable for such a surface is one thing, that on the Mapes farm is another thing. When we talk about the advantage or uselessness of getting down deeper, let us know what kind of earth we get into as we go down.

Mr. George Geddes, Syracuse, N. Y.—Mr. Chairman: I came here simply as a listener, and I have been very much gratified by what I have heard. If the report or statement of the chairman of this committee had gone out without qualification, I should have regretted its publication, but with these soils set before us by Mr. Lyman we have a demonstration of the importance of regarding the mechanical and the chemical make up of subsoils when we discuss deep plowing. I have been for almost three score years a tiller of the soil. I plow the lands my father cleared, and the more I observe crops the more I see that the roots of plants will, if they can, reach a great depth in the soil. Corn and wheat, even, will send rootlets two and three feet down when the character of the subsoil favors such invasion. I had the meanest looking, most unpromising soil to begin with that a man ever tried to shove a spade into. It was a naked, barren shale, the growth scrub white oak. My father was blamed for making a selection apparently so bad. But I can report crops that will compare very well with the showing of Dr. Trimble. We cannot up there raise that kind of corn (the Ohio Dent); but we can raise corn that will give sixty shelled bushels to the acre. How have I produced this fertility? Three things have done it; clover, deep plowing, and the foot of the sheep. There is on old Spanish saying that there is gold under the foot of a sheep, and I have found it true. Those lands have not been manured with barn-yard composts. In my opinion, Mr. Chairman, we have plants, some, perhaps, that we regard as our worst pests, that

are working for our advantage as subsoilers. The effect of clover roots in drawing towards the surface virtues that lie below is well known. Now, let any man take a field infested with Canada thistles, and after plowing them under a few times, let him put wheat on that field. The harvest will no doubt surprise him. Some have advanced the seemingly wild idea that the Canada thistle is not an enemy, but a friend. This much is to my mind certain: its long, tough roots, piercing three or four feet into the subsoil, bring plant-food up to the surface, and give the roots of the wheat a chance to run deeper than they would in a field free of thistles. We talk about the drift. Now, what drift? The drift from what rocks or what formation? For instance, some years ago I dug a cellar in a hill of drift. The earth and boulders were scattered all around the excavation, and had a barren, repulsive look. But I plowed it and sowed oats, with a very fine crop as the result. Now that drift is a mixture of the various rocks all the way northeast to Labrador, or, for ought I know, to Greenland. There are granite, hornblende, mica gneiss, limestone. Such a subsoil is worth turning up; and, as Mr. Lyman urges, this is all a question of the character and composition of the earth which lies immediately below the humus or mould.

Mr. N. C. Meeker.—If one would raise grain crops, the soil must be plowed, and deeply. As regards the use of lime, there may be some ground, mostly muck, that will stand 1,000 bushels to the acre. I know of an orchard that was killed by the application of 600 bushels to the acre. Usually, 200 bushels will be all that land will bear. At some future time I will read a paper on this subject of deep plowing, for it is not generally understood.

Mr. A. S. Fuller said this report of Dr. Trimble's ought not to be printed, as it is likely to do immense injury. People are naturally lazy enough, and such a paper will confirm them in their laziness.

Mr. R. H. Williams.—Let us have the whole subject laid before the people. Many things are to be taken into account. Quicksands and underlying water are to be avoided, and sunshine and air must be sought as well as depth.

Mr. Geo. Geddes.—I read the reports of your club with great interest, and I remember that a gentleman writing from Michigan used a formidable argument against deep plowing, which is that when earth is moved it has a tendency to pack. It is true that when ground is in a natural state it is looser the oftener it is moved. It is impossible to take earth out of a cut and make an embankment of

the same size as the cut. The earth out of a post hole cannot be made to fill it. These are certainly facts, but however strong they may be they do not prove that deep plowing is not beneficial. The natural earth is made porous by the roots of trees and vegetation, and when removed, in a manner it collapses. But at the same time it becomes aerated and fitted to receive new roots, which in a natural condition it is not so well able to do.

Mr. Horace Greeley.—Mr. Chairman, if I am under a delusion on this matter of deep tillage, I have been drawn into it by a very ancient and venerable authority. Here it is. I read from St. Matthew's gospel, chapter 12, verse 3. They are the words of Christ himself. "A sower went forth to sow; and when he sowed some fell by the wayside and the fowls came and devoured them up! Some fell on stony places where they had not much earth; and forthwith they sprung up *because they had no deepness of earth: and when the sun was up they were scorched; and because they had no root they withered away.*" Now all I contend for is the agricultural truth stated in this scripture, that as a general rule, applicable probably to nine out of ten of the cultivated acres of this continent, a soil so tilled that roots of crops can reach down into the subsoil for their food, is far superior in a dry season to a soil where the roots must remain within a few inches of the top. I am not unacquainted with that Jersey soil. I was there in 1864; the season was very dry, and the corn was so affected by drouth that I doubt whether it gave ten bushels to the acre. There are soils where nature has done up the subsoiling for all time for the fortunate tillers. I know a few such regions. This strip in Salem county, which the committee visited, may be one of them. From the specimens of subsoil brought away by one of the committee, I should say it is remarkably good both in its mechanical condition and its composition. There are places in California where if you water vines a little for two or three years, till the roots get down, they will grow and bear without rain. So of some of the corn lands of Illinois; a plowing of two inches, just enough to cover the seed, will insure a fine crop. But such lands are the exception, the rare exception, and not the rule. At some future time, Mr. Chairman, I will read before this club not exactly a paper on deep plowing, but a definition of what I understand by deep plowing.

Mr. J. B. Lyman.—Mr. Greeley alludes to the goodness of this subsoil. Now this is a relative word, and we have the means of com-

ing at the precise truth about it. As a general thing, analyses of soil do not amount to much, but in this case it may be of considerable value; and I move that these pots be given to Mr. J. A. Whitney, who is an expert in chemistry, with the request that he give us, if not an exact, at least an approximate analysis.

Mr. George Geddes.—In this case I should say that an analysis may be of much importance, and I hope it may be done.

The club voted unanimously to ask Mr. Whitney his opinion, as a chemist, of the composition of these earths, and their respective value as furnishing food for plants.

Chair.—It seems proper to me that the dissent or qualification of Mr. Lyman, which was not in writing, while the report was, should be considered as a part of that paper, and that the report be recommitted for this purpose. A motion to this effect was made and carried.

A communication of much importance was then read on the

Cattle Disease.

No. 32 Cortlandt Street, New York, *November* 10, 1868.

Hon. N. C. Ely, *President of the American Institute Farmers' Club:*

Dear Sir—I have received instructions from Hon. Horace Capron, commissioner of agriculture, to institute a preliminary inquiry as to the prevalence of the lung plague, or contagious pleuro-pneumonia of cattle. I regret to state that evidence has already been afforded me of extensive and recent losses by this disease on Long Island, in Pennsylvania, and Maryland. As usual, its progress is very insidious, and whilst hundreds have been impoverished by the loss, especially of cows, a far larger number will in all probability experience similar misfortune if rational measures are not adopted for the extinction of the malady.

It is difficult, by unaided personal inquiry, to ascertain satisfactorily the whereabouts of the disease; and as the proceedings of your club are extensively read, I should esteem it a favor if you would make it known that *I desire statements in writing concerning the stocks and localities visited by the lung fever.* The points on which information is most needed from individuals are as follows:

1. Amount of stock usually kept.

2. How the stock is renewed, by breeding or purchase, and where cows were bought.

3. First appearance of the malady.

4. Total losses by the disease, and what measures have been adopted to prevent them.

There are many persons who would probably wish to enlighten me but for the desire that it be not known their cattle are diseased. All such should be informed that their names would not be published unless they should desire it, as our object is to benefit the many and injure no one. Correspondents may address me at the department of agriculture, Washington, D. C., or at 32 Cortlandt street, New York. Hoping that you may succeed in eliciting useful information for which I shall be very thankful, I remain, dear sir, yours faithfully,

JOHN GAMGEE.

SURFACE MANURING.

Mr. G. Ludwig, Ridgeville, Del., inquires whether ground intended for potatoes next year should be manured now, or next spring, and whether sedge on an old field should be turned over this fall or next spring before planting corn.

Mr. N. C. Meeker.—Apply the manure this fall, and the ground will be in a much better condition for potatoes than if applied next spring, because fresh applied manure has a tendency to rot. Of this there is not the least doubt, however much some may deny it. It is best to turn the sedge in the spring; during the season of working the corn the sedge sod will be torn to pieces and rot. Nothing can be gained by turning this fall, particularly if the soil is light, which is natural for sedge.

SALTING BEEF AND PORK.

Mr. J. G. Freeman, Monticello, Minn., wishes information as above, and how to cure hams.

Mr. N. C. Meeker.—I never failed in salting meat but once, and this was the first time I tried. After that I was sure to use salt enough, but no water added, and had no trouble. Hams are generally put on the top of the other meat, and in about a month are taken out and smoked with cobs. Beef becomes quite salt after staying long in the brine, and the brine bloody. It is a good plan to replace the brine with new brine, and at best it requires watching. Lean does not keep as well as fat meat. As to adding molasses, sugar, saltpetre or any such ingredients, they are useless. Meat can be rubbed well with salt, and placed in a box, or be piled up, but the surest and best way is to pack in clean barrels. A molasses barrel, or one in which meat has

spoiled can be made clean by being filled two or three times with clean water, to which ashes may be added; then invert the barrel, and place under it a good smoke of cobs.

Adjourned.

November 17, 1868.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Tennessee Lands.

Mr. Frederick Daurs, Hammonton, N. J., among other things, somewhat personal, wrote that he went from Jersey to Tennessee, and that he has returned entirely satisfied that a poor man cannot live there, and a rich man would not. He adds he has been cruelly deceived, and wants to prevent others from being wronged as he has been.

Mr. Solon Robinson.—Tennessee is a very large State, and it is very indefinite to speak of the State in this general way. Now I know that some parts of the State are superb, and can hardly be excelled for farming. Other parts are of course poorer, as is the case in all States.

Mr. W. S. Carpenter.—I am convinced that the State is well adapted to fruit of all kinds. In places peaches have been so abundant as to rot on the ground.

Mr. J. B. Lyman.—Such a letter ought not to pass without an expression. I lived there myself five years. One-half of it is equal to the best part of the State of New York, and the climate is superb. Improved land, equal to the best in western New York, can be had from fifteen dollars to twenty dollars an acre.

Mr. N. C. Meeker.—This is rather too fast to compare Tennessee with New York, for most farms, unless on the bottoms, are nearly worn out and a farm of fifty or 100 acres will not give a family much living, while in western New York it will give abundance. More than this, grass does not grow naturally, and if it did, the feed would be short during the long hot summers.

Mr. Wilcox, of Buffalo.—The main difficulty with the old farms of Tennessee, having a limestone basis, is that with a tender, loamy soil, they are badly washed by rains. In buying a farm one will get a fair proportion of this washed land, which is wholly unproductive. One should be careful in selecting a farm.

THE FUTURE OF APPLE TREES.

Mr. G. W. Southwick, Madison, Indiana.—This is the oldest settled part of the State and formerly we used to have abundance of all kinds of fruit, apples included, but for the last few years apples have almost uniformly failed. The soil is a heavy yellow clay, and back from the river tolerably level, apple trees seem thrifty enough; make and mature wood well enough but the fruit fails to appear. Now I would like to inquire what renovating fertilizers we can use or what other means we can employ to give us back what for some years we have not had, good fall and winter apples.

Mr. T. C. Peters.—After the roots of the forest decay some land becomes very hard and thorough drainage will be a great help. Fifty years ago when I was a small boy I held the trees of an orchard which my father planted. A few years since they began to decay, but giving them cultivation and applying a few bushels of ashes and chip manure to each tree, they were restored to their former productiveness.

Mr. Wm. S. Carpenter.—Draining is not a remedy for I have tried it. I have no doubt but that the cause of failure lies in adverse atmospheric influences. Of course insects do much damage but when the season is favorable, and the blustering east winds do not prevail we have fair crops. I am decidedly of the opinion that after a while the former fruitfulness of our orchards will return, and I think we should have faith.

Mr. Solon Robinson.—All through the eastern States many have taken great pains, have fertilized and cultivated, and even planted new orchards, but so far from finding a remedy the trees have died. Everywhere our apple trees are decaying, and they seemed doomed. This is the most important subject that can engage the attention of the American farmer, that, if possible, the most valuable fruit growing in any latitude may be saved.

A visitor suggested that orchards be planted on new land, and that leaves and leaf mold be used as a fertilizer. A timber belt as a protection will be important, then the orchards will be in the condition they were when the country was first settled.

Mr. Wm. S. Carpenter.—I can show an orchard fifteen years old, planted thirty feet apart, and with the limbs interlocked, and more thrifty trees cannot be found. This does not look like dying out. Again, I say, in a few years our orchards are likely to return to their former fruitfulness.

Mr. A. S. Fuller read from the *English Floral World* a statement made over 100 years ago that a certain apple, which is still doing well, was dying out, and that apple trees, like folks, grow old and die.

Mr. George Geddes.—The county of Onondaga was once famed for its apples. But when the first growth died or grew old there was an interval when we complained of scanty apple crops. Now we have a goodly number of young orchards, and there is no complaint about fruit, though the trees are not such generous bearers as those first planted.

Dr. J. V. C. Smith.—I think the differenee may be found in the habits of people. We do not work as the former generation did. We do not dig about our trees as that fig-grower in Palestine did. We are more slack.

A visitor.—That does not account entirely for the difference. When I was a boy the east wind blew in May just as it does now, and men were slack about their orchards just as they are now, yet we had apples a plenty and quantities of cider. Some men grew rich of making cider brandy, and others grew poor a drinking of it.

Dr. Isaac P. Trimble.—We might as well talk about the wheat dying out or the corn dying out, because some farmers make poor crops for want of manure. Cultivate orchards as you do tobacco and you will have apples.

Mr. S. Edwards Todd.—Dr. Smith has driven a nail or two in this discussion which I desire to clinch. In my walks with many people in the country, I am often met with this remark: "I wish you could tell me what ails my fruit trees." I met with several farmers on Long Island and in New Jersey who thought their peach trees had the yellows. I assured them the borers were the sole cause of that unthrifty appearance. And I have brought to the club a stump of a small peach tree, from which I cut out with my own knife eight borers. You see the tree is completely girdled by the borers; and there are more borers in the wood. Thousands of fine trees are destroyed by the borers, when the failure of the trees is attributed to the east wind, or something else, which never had an existence. When I was a boy my father employed a pruner to go into his large orchard and prune every tree with the axe; and since the orchard endured that unexampled and wanton slashing the fruit has been failing. Where those large limbs were cut off, the trees began to

decay, and the effect has been, and now is, disastrous on the productiveness of those orchards. If farmers will plant their trees in as fertile soil as they were accustomed to do when the country was new, and will apply wood ashes, apple trees will be loaded with fine fruit.

Mr. A. M. Powell.—I know a successful orchard in Columbia county, which my father and myself cured, for we exterminated the borers and the caterpillars ; cultivated and seeded down in alternate years, and manured well. In one part raspberries were grown, and as the cultivation was better here, more manure was applied than on the other part ; this portion yielded more fruit, and showed more thrifty trees.

Mr. Solon Robinson.—As regards pruning, I will say that I have an apple tree which for fifty years has not been pruned, and during ten years it has not borne ten bushels of apples.

Mr. P. T. Quinn.—When apple trees have had their just dues, six times out of ten they will succeed. If the same attention is given them as to corn, potatoes, and cabbage, they will bear. As to pruning, it is conceded by all fruit growers that it is absolutely necessary ; but I grant that indiscriminate pruning does more harm than good. To know how to prune properly is one of the first steps in horticulture, and the leading idea is to give to a tree an open top.

Dr. Halleck.—The apple tree, as we now know it, is artificial, and its fruit is artificial. In its natural state it bears fruit the same as the oak bears acorns. Having taken it from its natural state it is subject to conditions and influences which we do not clearly understand. Epidemics sweep over our country and we have agues, the cause of which we know nothing. There is certainly a decrease in the apple crop of the Hudson river country. Even hickory trees which have borne many years are becoming barren.

Mr. A. S. Fuller.—I can raise trees thrifty and vigorous; in this there is no trouble, but insects are so numerous it will require a man constantly to keep one tree clean. These are at work now on the hickory and other trees. There is now a grape curculio peculiar to this fruit; and I have received a sample of grapes from Canada sent by a man engaged in raising seedlings, and the seeds of every grape were infected with a worm.

Mr. John Crane, Union, N. J.—I have an orchard which my grandfather planted 100 years ago, and in this and in other trees of my planting the leaves are affected. I have an orchard planted

fifteen years ago which has not borne a peck. If we have no fruit what is the use of talking about insects? It is like locking the stable door when we have no horse. Now, my failure is not for want of fertility or cultivation, but the leaves evidently are affected with blight. Four miles from me is an orchard, mostly Baldwins, on a western slope with timber belt on the east, and it bears every year.

Presentation of a Gavel to the Chairman, Mr. Nathan C. Ely.

Dr. J. E. Snodgrass, on the part of the club, took the platform and presented a gavel to the President. It had an ivory head in the shape of a sheaf of wheat, a handle made from the wood of an apple tree grown on Prof. Mapes's farm, ornamented with a grape vine, with a strawberry at the extremity, all executed by one of the best artists in this city.

Dr. Snodgrass said: Mr. Chairman—Acting on behalf of a committee which embraces many of the regular members of this club, I have the honor to be the medium for expressing our sense of the able, the cheerful, and impartial manner in which, for six years past, you have discharged the office of chairman of this club, and as proof of that esteem, I have the honor of presenting you this gavel, which in its workmanship and material, we think has a beauty and a significance that will make it of intrinsic value in your eyes. The head is of solid ivory, cut from the tusk of an elephant, the type of dignity, strength and patient toil. Its form is that of a sheaf of wheat, that has for ages been the emblem of tillage and the sign of plenty; representing the farmer's best reward as well as his severest work. It will carry your mind back to the time when the back-trying sickle had not been superseded by the grain cradle, to say nothing of the reaper with pleasure-carriage and cradle combined; for these now indispensable improvements did not enter into the wildest dreams of the devotees at the shrine of the golden-crowned Ceres. Examine this handle at your leisure. You will find carved on it not only the grape, that oldest and most widely grown of all the small fruits already referred to, but that berry which comes just when we most need its acid to neutralize the alkaline matter derived from too much use of winter food. I allude to the strawberry, which is represented on the end, of which it will suffice to quote the quaint language of Dr. Boteller, as quoted by old Isaac Walton, "Doubtless God could have made a better berry, but doubtless God never did." Here, too, we have the rose, that oldest representative

of the more poetical department of our noble science, whose proverbial sweetness Shakespeare tells us no other name could dispel.

It is ever cheerful, whether found, as it has been, amid the glaciers and the eternal snows of the very Alps, as well as in Sharon of old, or whether blooming beside the palace or hut, from its earliest unfolding in spring till that somber season when "the last rose of summer is faded and gone."

But especially we invite your attention, Mr. Chairman, to the substance of this handle itself. In it, sir, we present you a momento which we know you will not fail to treasure, a portion of the apple tree which had the pruning care of one whose name is dear to every lover of agricultural improvement, to every member of this club, where his voice was heard so often and so instructively. I allude to the late Professor Mapes, from whose farm, now so admirably managed by one (now present, as I am glad to see), on whom the mantle of the departed pioneer in deep plowing and unsparing fertilization, has so worthily fallen, as all will agree who have the pleasure of knowing him.

Of the apple, as the last emblem I shall mention, I might content myself, sir, with saying that, as among the larger fruits it, in universality of growth and use, is to the orchard what the wheatberry is to the field, indispensable to the farm worthy of the name.

The apple tree, sir, is now the most historic of all trees, at least, to the friends of agricultural improvement. It was under the first apple tree ever planted, according to the bible, that innocence, heaven-born though she was, surrendered to sin, to be followed, as Milton sings, by all our woes, including even death.

I mention now a second surrender under an apple tree, which grew in our own southern Eden, the cause and the immediate consequences, the world-concerning consequences, of which all are familiar. That was a surrender of which I will only say, that I trust it will have opened a new and beneficent field for the influences of this club, as one of the more remote consequences over which I am sure, we shall all rejoice.

But, Mr. Chairman, if it be true, as the divine fact quoted assures us, that

"Peace hath her victories,
More renowned than war."

then was there a surrender under still another apple tree, which grew nearer to us—the identical tree, I may say, from which this handle

was carved—much more important to the more immediate interests represented by this club, than the last named surrender. Under it the old come-easy-go-easy-take-all-and-give-nothing system of agriculture, with that shallow plowing, which still finds at least one advocate here—by no means shallow-pated either, I am bound to say—surrendered to the newer and better system of deep plowing, and unsparing fertilization, under the guidance of science herself, as understood and appreciated by Prof. Mapes.

But I should fail of a most essential part of my duty, were I to omit to tell you wherein we think your especial merit lies in presiding so ably and with such general acceptability over this club. That is to be sought in the circumstance that this *is* a "club," which is without the set rules and anticipatable proceedings of a more deliberative body, and that it requires something beyond a knowledge of parliamentary rules, indispensable as they are in all meetings, which something, is readiness to provide for emergencies and harmonize contrarieties of topics as well as temperaments, inseparable from the meeting of men who have, it may be, come in contact for the first time, bringing with them creations of genius or art, or the products of the farm or the garden to exhibit, or merely loaded to the muzzle with opinions, the instantaneous discharge of which, they believe in their souls, is indispensable to the enlightenment of the world, and who therefore seek to fire them off accordingly, all at once, no matter what larger "bores" you may feel it your duty to hear from. So that, if ever the phrases, "*suaviter in modo fortiter in re*," that is, sweet as sugar, but firm as a rock; or "*otium cum dignitate*," sober as a judge and dignified as an alderman; if ever these phrases, I say, signify indispensable qualities anywhere, in a presiding officer, it is here.

You, sir, have doubtless heard of the boy who furnished a switch for his own back. It may be that some of the presenters of this tribute, and Webster significantly enough defines a "gavel" as a "tribute," and a "sheaf," also should realize the fate of that unfortunate boy. If so, it no doubt will be for the general good, and the martyr will cheerfully submit, as he should. And we beg of you to use this gavel unsparingly whenever required, no matter whom it silences. Let it say, for you, as your namesake, Nathan of old, said even to a king, "Thou art the man!" Let it do this for the increased usefulness of this club, so that its 10,000 letters asking for light or seeds, and as many more sent with packages annually, by our silent

but most efficient secretary (Mr. Chambers) to bless as many fields and gardens, shall be doubled in number and in beneficence to the masses throughout the land. And this club, sir, is destined to be more and more useful to this country and the world. Future generations will acknowledge the vast usefulness which you have so generously aided it to accomplish. Some poet will be found saying of those who meet here, as Emerson said of the farmer heroes at the battle of Concord,

> "Here once the embattled farmers stood,
> And fired the shots heard round the world!"

The chairman made a happy impromptu speech, though he was at some disadvantage, for the affair was a surprise, and the other speakers were all well prepared. He referred to the experience he had acquired in presiding over several municipal bodies in this city who had presented him with similar marks of respect, but none were so much valued by him as this evidence of the respect of the American Institute Farmers' Club. No circumstance, he said, was more affecting than the constant reminder he had, in the handle of the gavel, of that pioneer of sound and high farming, Professor Mapes, whom he respected as much as any living or any deceased member of the club.

J. B. Lyman.—Mr. Chairman, an occasion just like this may not return again for many sessions of this club; and as the words we utter here, be they wise or foolish, are generally printed, and reach a very large rural audience, you will excuse me if I refer to this manuscript in order to give exactness to what I may say. We are entering upon a new and noble epoch in the art and science of agriculture on this continent. Until the middle of this century, the vast extent of fresh soil, rich with the forest mold of ages, guiltless of the plow, and cheap almost as water or sunlight, took away the necessity for care and skill in our tillage. What matter if the old farm wore out; an acre of new land did not cost as much as a pair of kid gloves. Increase and influx of people, with multiplied railroads, have changed all this. There is no great amount of land in desirable locations that is now cheap. We must, then, cling to the ancestral tract, and learn to work with wisdom, and art, and science, what our fathers cultivated with rude and primitive tillage. The growth of great metropolitan centers has also changed the relative value of agricultural lands. When New York had only 100,000 mouths to feed, a man was a dolt to linger under the pine saplings of south Jersey, when he could get fifty acres in Genesee or Wabash valley for $100. Now, when New

York has a million of mouths clamoring for daily bread, and Brooklyn, Newark, Philadelphia, and the sisterhood of great and growing towns around them, two millions more, we may call that man a sound philosopher who studies how to take the greatest number of bushels of potatoes from an acre of Long Island or south Jersey sand. Another circumstance makes this a turning point in agriculture. For eight years a bitter civil strife has checked enterprise and sometimes blasted production over nearly half this republic. That is now over and ended. In eleven great States a total change in the agricultural system has begun and must go on. The God who made the geology and the climate of this continent designed the region fanned by the breezes of the southern gulf as the garden spot of America; and no stretch of human folly or madness can avail to check the action of eternal laws. Those sunny regions are open to the march of the grand army of peaceful progress. A day of wiser and sounder tillage has come for those million of acres that now wave with rustling sedge-grass, or give only fox and rabbit coverts in their tangled and briery thickets. How do we of this Farmers' Club stand related to all this prospective advance? Mr. Chairman, and gentlemen, circumstances have put it into the van of this march! Not that we know more than others. On the contrary, I feel that there is hardly a solid farmer who does justice to ten acres of land that cannot teach us some of the first principles of the art. Our mission is not to originate, but to spread ideas. This is the agricultural center, as Broad and Wall streets are the financial center. When we say things here we should regard not only the ring of kindly and familiar faces that are framed in these four walls, but that remote, though real, audience spread all around us, from the pine solitudes of Mount Katahdin, on the utmost verge of Maine, to the musquito-covered savannas of western Texas; from the everglades of Arcanian Florida to the far shore "where rolls the Oregon, and hears no sound save his own dashings." Mr. Chairman, as a newspaper man and journalist by profession, I have investigated the subject, to reach this impressive conclusion—that when a remark or an idea of more than ordinary force and value is spoken in this club it reaches an audience of two millions of readers. The evening lamps in four hundred thousand dwellings shine upon the columns where these reports stand in type. They are read in palaces under the bravery of gilded chandeliers. They are studied out in log cabins where the wind, blowing through the chinks of the punshon floors,

make the tallow candle drip upon the paragraphs. The ablest of all the public men of Greece, whenever he stepped upon the bema, was accustomed to pray to his heathen gods that he might say nothing unworthy of the Athenian people. Our audiences, Mr. Chairman, are ten times greater than any ever reached by the words of Pericles, and shall we not have some solicitude lest we say things here that are unworthy this great people, and the magnificent interest which we represent? If they ask us for a fish, shall we give them a serpent? If they put us a civil and important question, shall we answer with a conundrum? Is it becoming in us to discuss whether round eggs hatch roosters and long eggs pullets; whether snakes eat strawberries; whether mare's milk is good for young pigs; whether frogs eat musquitoes; whether horse hairs turn into water snakes; whether pork butchered in the last quarter of the moon will shrink in boiling; whether tree-toads are poisonous; whether there is dyspepsia in a pickled cucumber; whether swine's flesh is fit for food. It is time, Mr. Chairman, and gentlemen, it is time to leave all these questions to village wiseacres and moon-struck philosophers. If we want to do good, if we would associate our names with interests that are perpetual, if we would have the respect of remote States, and the honor of those who come after us and will stand in our places when we are crumbling in the soil about which we talk so much and know so little, let us be earnest, manly workers. Let us take the ax-helve in two hands and cut for the heart of the oak. Let us not stop to spin yarns while the pig weeds are growing faster than the corn. Gentlemen, we have done a great deal; we have spread broadcast a great number of valuable ideas, of important facts, of useful experiments, but after all we have only scratched the surface, running our little shares three inches deep, while for miles and miles around us uncounted granaries of food lie deep in the bosom of unsunned mold. We enjoy one single and eminent advantage over every other agricultural society; over the department of agriculture itself. We have a broad, well paved avenue to millions of readers. We have regular and weekly access to the ear of the people. Without presuming to dictate or foreshadow too much, you will allow me, Mr. Chairman, to allude to the lines of development and usefulness that are upon us. We have a number of gentlemen who are competent to conduct careful and important agricultural experiments, and to greatly advance the interests of solid farming. The country would repose in the verdict of Mr. Quinn or Mr. Lawton,

Mr. Fuller or Dr. Hexamer, as the best authority on any question which they have fully and fairly investigated. For the analysis of ash or plants, leaves, fruits, or earths, in Dr. Feuchtwanger, in Prof. Tillman, and in Mr. J. A. Whitney we have gentlemen capable of giving a valuable and scientific opinion on questions of agricultural chemistry, With such facilities as we have for spreading ideas, we ought to be a metropolitan head-center for whatever is new; whatever is sound; whatever is helpful and of good report in the science of tillage, and in all rural economy. There is here given us what so many able men have struggled for in vain; what so many shrewd men have failed to create; what no wise man ever refused to embrace —*a fair opportunity.*

Mr. P. T. Quinn.—There is one subject, or rather one name in the remarks that have been made which I cannot allow to pass without one word of grateful comment from me. It is true, as the speakers have said, that Professor Mapes was a pioneer and reformer in agriculture. As early as 1840, and constantly from 1845 till his death, nearly three years ago, Mr. Mapes was insisting on the importance of estimating land, not by superficial area, but by cubical dimensions. For spreading acres he cared little. His question was ever for the depth of a soil. Of the professor, as a man and a friend, it is not for me here to speak. I cannot, for my heart is full. This I will say: The more I till the soil, the more I study the crops, the oftener I am reminded of wise, sagacious, prophetic remarks that he was often making. In the doubts and difficulties of farming I find by recalling or re-reading what he said, that his clear mind had been before me, anticipating the doubts, marking all the shoal waters, and sounding all the deep places of agriculture. He always loved and sustained this club, and, of all the deceased members, those whose remains slumber in the earth and whose spirits walk the green pastures above, none, I am sure, would more rejoice to see the magnitude to which we have grown, and the still more brilliant future that now opens before us.

Dr. Isaac P. Trimble.—Mr. Chairman, have we got done with this mutual admiration business.

Mr. James A. Whitney.—I hope the time will never come, Mr. Chairman, when we shall have done with a just and temperate admiration for those living who labor for the promotion of interests so vital, nor with reverence for the dead who rest from the rural labors, and whose works do follow them. For my part, I deem it wholesome

and wise to pause a moment in our ineffectual discussions about apple trees and grub worms to take our bearings and calculate the value and drift of our labors. If careful experiment will do much to settle mooted questions in tillage, and I know it will, shall we not experiment. If scientific scrutiny will do anything to advance sound farming, I for one am ever ready to add my industry, such as it may be. The eulogies of Professor Mapes, and I am sure they are all just, show one valuable truth, that the one man who above all others made the deepest mark on the agriculture of his time, was the most thoughtful and learned agricultural chemist that ever took part in the deliberations of this club.

Mr. Adrian Bergen alluded to the services of the late Judge Henry Meigs, for many years the secretary of this club.

Mr. Wm. S. Carpenter.—It was through the instrumentality of Mr. Thaddeus B. Wakeman that this club was organized, but the great progress is due to our venerable friend Mr. Solon Robinson, by attracting towards it the eyes of so large a country audience.

Mr. Wm. Lawton then gave a number of interesting reminiscences of the club in its early day, and spoke with much feeling of old associates.

Mr. Geo. Geddes said he was struck with the important omission in Mr. Lyman's remarks; and this was the work which the reporters were doing. Often they gave more force to a man's utterance than he himself gave.

Another present was made by the chairman to Dr. Trimble, which was a handsome picture, followed by a pleasant speech from the recipient.

New Potatoes.

Mr. N. T. Jackson, Spring Mills, Allegany county, N. Y., sends a box of seedling potatoes, the seed of which came from Chili, and as they did well with him, he wishes others to try them. This will be done, and a report made.

Mr. E. M'Connell, New Castle, N. Y., sends a photograph of a seedling from the Buckeye, two weeks earlier than the Early Rose, but he has none for sale.

An agricultural picture, by Miss Cornelia Beach, Montezuma, N. Y., has been received, and will be appropriated as designed.

BARBERRY HEDGE.

Mr. F. A. Fuller, Hastings, Barry county, Mich., speaks favorably of this hedge in his State, but he wishes to know whether it blasts adjoining crops. The answer is that an intelligent man made quite a journey through a farming region in Connecticut last harvest to ascertain if this were a fact, and after a full trial he could find no evidence.

STEEL PLOWS.

J. K. Bull wishes to know if steel plows are better than cast iron in sandy, gravely, or hard-pan soil.

Mr. N. C. Meeker.—Steel plows are used more in the west and southwest than cast iron, and on light soil they are preferred.

FENCE POSTS.

Mr. Isaac Eyre, Attleboro, Bucks county, Pa.—In 1842 I helped to make and set two gate posts that were hewn both together, from the body of one white oak tree, which was perfectly sound; the one set butt down rotted off in twelve years, and the one set top down was not rotted entirely off at the end of eighteen years, and they were only eleven feet apart. In 1843, I set thirty-five panels of good cedar fence, with red cedar posts, most of which were set top down, and they are yet standing, but all that were set butt down have rotted off and have been replaced. In 1844 I split two posts from a sound chestnut log, and set them within eleven feet of each other; the one set butt down has rotted off, and was replaced several years ago, and the one top down is a good post, and yet standing. I have now on my farm many posts set top down that have been standing for the past thirty-one years, and not one butt down left that was put in at the same time.

BLACKBERRIES.

Mr. Joseph Garst, Springfield, Ohio, wishes to know how blackberries are propagated or managed.

Mr. N. C. Meeker.—Nurserymen raise them from root cuttings, made in the fall or even spring, and planted in drills in well prepared ground. They are best planted six feet apart, the richer the ground the better, and cultivation should be thorough from spring to September. The Kittatinny and Willson are the best varieties. It is hardly worth while for one who does not understand the management to undertake propagation, nor for men unacquainted with

small fruit culture to rush in, expecting to get rich. Fully one-half of those who cultivate the small fruits would make more progress if they should hire out for a year to some good nurseryman at fifty cents a day.

THINGS USEFUL TO KNOW.

Mr. R. Clymer, Franklin, N. Y.—An iron kettle, which had been an unsightly nuisance for twenty years, in consequence of having a crack a half an inch wide extending from edge to apex, and a hole through the bottom one and one-half inches in diameter, was mended thus: The crack was stopped by hooping the kettle with heavy band iron as you would hoop a barrel; and the hole was filled with melted zinc, enough of the metal being allowed to run through below, and enough to remain above to form a good head upon each side. The kettle is now used for boiling feed for hogs, and it is "amaist as good as new." Small sand-holes in pots and kettles can generally be stopped by inserting in them rivets or burs, such as tinners use for uniting the seams of stove pipes, and battering down the ends. If the hole is not large enough to receive the rivet, enlarge it with the end of a file or other suitable instrument. An old basket, whose bottom had caved in, except upon one side, was thus mended. A piece of sheet zinc was cut into strips three-quarters of an inch wide, and six inches long, and the strips thrust under the horizontal splints of the basket so as to reach three inches past the break, and the ends bent back so as to clinch around splints at each extremity, and the old basket, with careful usage, will do service for another course of years. To stop holes and cracks in tin pans, a little preparatory fixing is necessary. Get half a pound of solder, and granulate it by pouring it melted into cold water, in as small a stream as possible, and holding the ladle as near the water as you can. Next prepare a flux by dissolving some bits of zinc in an ounce of muriatic acid. With a dull knife scrape a bright surface around the hole in the pan to be mended, apply a drop of the muriate of zinc, lay on a grain of solder, and touch it with the hot copper soldering tool, or any hot iron will do, or even a candle held under the pan will melt the solder and fill the hole. When you go to the cobbler's to get a shoe mended, notice how he makes his "waxed ends" and how he fastens on the bristles, then purchase at the hardware store a ball of shoemaker's thread, black wax, harness makers' awls and needles, if you prefer them to bristles; make up a lot of waxed ends, and when your harness breaks,

sew it up yourself, and save your carpet and shoe tacks for their more appropriate uses. When you take a barrel to the cooper's to be re-hooped, see how he prepares the hoop, the "lock," and how he drives it on. Then go home, and cut some slim straight poles of hickory, white oak, yellow birch, or water beach, of suitable size and length, split and shave to proper dimensions, and then bend them to the proper form and hang them up to season. When you have another barrel requiring to be hooped, do it yourself, and pray that the cooper's meal barrel may never be empty. There are a thousand little jobs a farmer can do to kill time on a rainy day, nearly as well as a mechanic, if he will only keep his eyes open and see how mechanics do.

Adjourned.

November 24, 1868.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

New Excavator.

Mr. A. P. Plumb, Denver, Colorado, sent a photographic sketch of the above, stating that it will cut a ditch, well, trench land, and throw up embankments at one-eighth of the cost of doing the same by hand. It is worked by an engine of eight or ten-horse power, set on large wheels, and it operates wherever the ground is free from stumps and large stones.

Mr. Solon Robinson.—I could tell better about such an invention after seeing it, but I doubt whether a locomotive engine can work on the soft ground of the west. The English method, using a stationary engine, seems the only practicable one.

Earth Closets.

Mr. A. B. Crandell read the following paper:

The public wealth, says a thoughtful writer, runs to the sea through the city sewer. In consequence the land is impoverished and the water infected. Hunger rises from the furrow and disease from the river. How to remedy this evil is an important question. The difficulty is that, under the present sanitary system, sewage becomes so diluted as to be generally unavailable, an ounce of solid fertilizing matter being mixed with ten or fifteen gallons of fluid. At Edinburgh something was done in the way of precipitating the valuable constituents by means of milk of lime, and thus was produced a

portable manure said to equal guano. Burnt clay has been used as an absorbent, and other expedients have been resorted to, but as yet little has been accomplished, owing to the weak way in which the work has been undertaken. However, the problem must be solved. When it is solved, says our authority, and town waste is applied to the plain, the products of the earth will be increased ten-fold, and the sum of misery will be greatly diminished.

Science has decided that the most important part of sewage is human excrement. The Chinese knew its value centuries ago. It is quite impossible, says Liebig, to form an adequate conception of the care bestowed in that country on the collection of this true sustenance of the soil. No Chinese peasant, Eckeberg tells us, goes to the city without carrying back at the two ends of his bamboo two buckets full of what we call filth. Thanks to this practice, the land in China is as fertile as in the days of Abraham. Chinese wheat yields a hundred and twenty fold, and well fed are the 412,000,000 people of which that great nation is composed.

Wasted excrement, says Liebig, hastened the decay of Roman agriculture, and there ensued a condition the most calamitous and frightful. When the Cloacæ of the seven-hilled city had absorbed the well-being of the Roman peasant, Italy was put in, and then Sicily, and Sardinia, and Africa.

Statistics inform us that in 1855–6 nearly ten million hundred weight of guano was imported into England, and that in the course of fifty years, sixty million hundred weight of crushed bone has also been used in that country. Yet all this mass of manure, says Liebig, is not worth mentioning when considered in relation to the arable surface of Great Britain; and it is but a drop when compared to the flood of excrement carried by rivers to the ocean.

This subject, the utilizing of the ejecta of the population, is receiving increased attention in Europe. Mr. Alderman Mechi, of Tiptree farm, a true reformer and enthusiast, has never ceased by tongue and pen to urge its importance, and it has long been a prominent topic before the Royal Agricultural Society. A few years ago the Rev. Henry Moule, Vicar of Fordington, Dorset, made an advance movement, which, if followed, promises to result in immense benefit, and to come nearer than any previous attempt to the solution of the problem.

The chief principle, or first fact, upon which Mr. Moule's system is based, is the power of dry pulverized earth, especially clay, to absorb and retain ammonia and other fertilizers without arresting their

decomposition. This, used as a substitute for water in cities, is the reform he urges. He has proved the arrangement to be entirely inoffensive, and, for several reasons, preferable to the closets now in general use.

The mode of action is the delivery of a small quantity of prepared earth directly upon the deposit. This entirely absorbs all moisture, and deoderizes the offensive material. Sufficient earth for a day's use of an ordinary family may be carried in a coal hod, and Mr. Mechi cites an instance where a cart load and a half served a school of fifty-five boys for six months. The same earth may be dried and used repeatedly, each repetition increasing its value as a manure, and, within certain limits, not lessening its deodorizing qualities. "Its daily removal will be as unobjectionable as though it were coal ashes."

Mr. Moule thinks that surface soil may be brought to the city and returned to the garden or field from which it was taken, in the same manner as straw for stables is now brought and returned. Companies, says he, will be formed, which will take upon themselves the working expenses, and find at least sufficient profit after paying thirty shillings per ton. The poor might have revenue, and the servants of the rich some gratuities, since a much less sum than that named would pay for supplying, removing, and drying the earth. He estimates that if one-fifth of the inhabitants of Great Britain were to adopt this reform, a million tons of manure equal to guano would each year be added to the supply of fertilizers.

There is certainly no reason this system of "earth closets" should not prevail both there and in this country. Every landowner, at least, should try the experiment, and thus secure sanitary cleanliness and more abundant harvests. Instead of making reeking cess-pools underground, and trying in vain to neutralize horrid stenches by honey-suckle and sweet-brier, let the receptacle be raised just above the surface, and let dried earth be used. This may be done without trouble in small towns, and by every farmer. The writer is informed that this economy is generally practiced in the prosperous village of Vineland, New Jersey, and that the ejecta of an ordinary household is held there to be worth, on an average, $150 per annum.

Mr. Moule states that, on account of variations, it is difficult to create an exact standard of value for this compost, but he gives, from his own experience, some examples of practical application. A handful or two of earth which had passed five times through the closet was dissolved in a pail of water, and this mixture being used

on young cabbages, it was found to be so powerful as to burn them. "With six pounds," says he, "I set in a piece of unmanured ground forty dozen Brocoli and Savoy plants, and no finer crop could have been produced. In 1860, a farm-bailiff received from me a hundred weight of compost from my stock of three cart loads, which had passed five times through a closet used by fifteen persons and afterward lain seven months in a shed. This the bailiff applied to a quarter of an acre, drilling in swedes. To the remainder of the field of four acres he applied an equal dressing of superphosphate. The result was, the roots on the garden acre exceeded in weight by one-third any specimens that could be found on the rest of the field. The next year this land was sown to barley, without further application of manure, and the same quarter acre yielded one-fourth more than any other quarter acre in the inclosure. Further experiments proved the compost to be fully as valuable as crushed bone."

Of course, in instituting this reform, especially in large cities, it will be necessary to encounter and overcome the powerful prejudice which always rises up to combat radical changes. Nevertheless, for the permanent welfare of all concerned, the opposition must be mastered. It is announced that a well known writer, Mr. George E. Waring, Jr., has prepared a pamphlet urging the importance of immediate action, and giving full directions as to the making and using of the "earth closet."

Mr. N. C. Meeker.—This is a well prepared paper. The invention referred to is of English origin. Mr. Waring's pamphlet should be in the hands of every householder, that attention may be called to the subject, even if nothing more results. So far as concerns abating the noisome and unhealthy odors arising from the source referred to, either in city or country, and perhaps more so in the country, nothing to me seems more important than a consideration of the subject. But as to applying the fertilizer for the growth of vegetables or any kind of food, for family use, I do not feel like recommending it, for I am adverse to using it, if anything else can possibly be had; and although its merits often have been urged, farmers have been reluctant to adopt it. We are continually reminded that the Chinese attach great value to this fertilizer, as though we were under some obligation to adopt their method. Now we have heard a great deal of progressed plant food, and of some not being enough progressed, but it seems to me that this article is progressed too

far; that is, in a manner it is worn out, and has ceased to contain the elements best suited to the growth of healthful plants to be consumed by civilized and intellectual people, which may be one reason why the Chinese themselves do not progress; but if it is applied for the growth of vegetation to be fed to animals, it may be progressed in a natural order, until, by new combinations with earthly and atmospheric gases, it is again fitted to enter into the elements of food proper for man. To this end I recommend it, and above all the invention for disinfecting the premises connected with every household.

Marsh Grass for Manure.

Mr. J. H. Moore, Brandon, N. Y.—Good success. My *modus operandi* is this: In the fall I spread a layer of grass in my barn yard, and after the cattle have lain on it a few weeks I add another, and so on until spring. I let it remain in the yard, which is two or three feet deep, all summer, and let my cows lay on it nights until about the last of August, when I pile it up in heaps of about ten loads each. The last of September I fork it over once, and the last of October I draw it to the field, while I pile about thirty loads in a pile ready for use in the following spring. I use this for corn or potatoes in the hill, and find it much better than green heap manure. This way I have practiced for years, and can raise as good corn as any of my neighbors.

Mr. Solon Robinson.—I would like to know what is gained by this work. Will men ever learn that the *cheapest way* to get manure is to grow clover and turn it under? There is nothing gained even by passing it through cattle. Spread grass six inches deep upon grass land, and all the fertility will be absorbed.

Dr. Israel Jarvis inquired whether weeds, being more abundant, would not be better for manure than grass.

Mr. Solon Robinson.—East Virginia is covered with the chickweed, which is their only manure. The southern cow pea would be better than clover, because two crops can be had a year. I know of no method so good for enriching land as to grow the manure on the ground. Weeds will not make good manure.

Dr. J. E. Snodgrass.—Weeds do not draw minerals and other fertilizing materials so much as clover. Now as to composting, that is important because it retains the liquid manure.

Mr. Shepherd.—In Pennsylvania, thirty-five years ago, they used to let their manure lie in the barn yard all summer, but now they

have learned better, and they take it to the field almost as soon as made. They have learned, too, that manure is much better when it has lain under cover, as in a stable.

KEEPING SWEET POTATOES.

Mr. J. B. Lyman, in answer to this question, said that a farmer in New Jersey was successful by having a fire on two sides of his dining-room, in which a fire was kept all winter. The roots were carefully handled in digging, and some of the best specimens were wrapped in paper.

Mr. N. C. Meeker.—In the southwest where everybody raises sweet potatoes, only a few keep them over winter, so great are the difficulties. Only a few succeed, and others buy of them for miles around. Still, many try, every year, by packing in cellars, with sand, chaff, or straw, or in sleeping-rooms, kitchens, and lofts, in boxes and barrels, packed with cloths, leaves, or other material, and about mid-winter they are rotted and thrown out doors. Some of those who are successful have a box-like hole in the chimney, which is on the outside of the house, and which is warmed by the fire-place; but this is expensive. Others keep in dry pits out doors; still others, trying the same methods, fail. Further south they are kept in pits, and generally with better success.

Mr. Wm. S. Carpenter.—One of the most important directions is to dig the potatoes before the frost kills the vines; if dug afterward they will not keep, however much care is taken. My method is to pack in a barrel, with a hole in each head, in which is a stick, and after it is filled I withdraw the stick, which is for ventilation. First, I put in a layer of shavings, then a layer of potatoes, and so on.

DESTRUCTIVE INSECTS.

Mr. Joseph Treat, Vineland, N. J.—The club ought to proclaim that fruit can be raised everywhere, in spite of all insects; that insects can be destroyed, and a new era introduced. Instead of so many insects, proving that we can never get rid of them, it is their very multiplicity which insures that we shall get rid of them, by making it an absolute necessity that we should, and nature tells us how, by the instincts implanted in the insects themselves. We never should have had insects in the first place if we had not departed from nature in the matter of birds. For more than 200 years we have gone on, persistently cutting away the timber everywhere, and driving the

birds before us in all directions, that at last, the insects have taken the place of the birds, and destroyed the balance. One gallon of black molasses, unfit for anything else, mixed with water and placed in old vessels will suffice for a farm from early spring till fall, answering from week to week, only requiring to have the moths thrown out; to be removed or kept covered by day, to preserve from bees, and to be filled up and kept sweet, as it gradually wastes or too greatly ferments. The same sweetened water, on plates, with cobalt, ratsbane, or anything similar in it, will poison the moths. But there is still a more universal means, for nature has made every insect a fire-worshipper. Little fires in gardens and orchards at early twilight, burning five, ten, or fifteen minutes, will attract and consume perfect swarms of moths, beetles, bugs, and curculios, and more directly save fruit than anything else. Light wood obtained and split fine beforehand, enough for the whole season, or flat-bottomed tin lamps, like those of the "campaign torches," will be money at 100 per cent in every man's pocket, who owns either garden or orchard. And picking up and boiling all fallen fruit, to kill the worms in it, will make two or three hundred to one less insects next year. These means forestall all ordinary ones, as hand-picking, sprinkling with oil, cutting out borers, destroying nests on trees, toads, turtles, chickens, ducks, that eat every tomato worm, and turkeys that gobble the new potato bug of the west, killing the parents and preventing increase, is beginning at the beginning, and striking at the root. The means are literally so many, that they become superfluous; half of them will do; what we do not kill in one way we shall in another. We might have known that we should find means, because it would become a necessity, and necessity is that which has done everything else. It is that which has given us the plow, which we should never have had if trees had borne bread; it is that which has given us the locomotive, which we never should have had if men had been able to fly, and it is that which has given us the cotton-gin, spinning jenny, and sewing machine, and which would, could wood and coal disappear, give us fire from water. So, when it becomes necessary, it is easy to find ways to kill insects.

Wisconsin Land.

Mr. S. B. French, Menomonee, Dunn county, Wisconsin.—The northwestern part of this State is new and just settling up, and it has a large amount of good prairie and timber land, and with a climate

similar to and as heathful as New York. Land can be had twenty or thirty miles back under the homestead, and mainly of good quality, for five dollars, while improved farms can be had for ten to twenty-five dollars an acre. We will have a railroad in about two years. We are just completing a $15,000 school house. Good openings for all classes of laborers, mechanics, professional men, and tradesmen.

DEEP-PLANTED APPLE TREES.

Mr. Daniel Cornell, Buckingham, Iowa.—In 1861 I planted twelve apple trees in my garden, twenty inches from the surface. They are four years old, and although they have grown well they have never blossomed, and there is no prospect that they ever will. My neighbor planted many of the same kind, and his have borne for three years. Did I plant too deep, and what can I do?

Mr. N. C. Meeker.—We should say too deep. Banking up trees has a tendency to make them throw out surface roots, but whether this would be a remedy we do not know. Surface roots are indispensable for the production of fruit, and in the course of time they will grow, or the tree will die. Meanwhile, cultivation must not be so high as continually to produce soft wood. If wood does not have a chance to harden late in the summer, fruit buds will not set. There was an apple tree back of our own door which received a good deal of wash, and there was considerable filling of what was first quality manure from the kitchen. Said tree would not bear, but it grew amazingly; finally it was slit through the bark of the trunk and limbs, and the bark split open; after that, there never was a tree in this world which did better. On that Dongala farm we had a tree in the garden planted near where the previous settlers had manured the ground, and there was a great growth, but no fruit until the bark was slit, when it began to bear, doing better each year. However, the apples not much, although the tree came from Rochester. The truth is, high living is unfavorable for man or beast.

NUTRIMENT OF GRASSES.

Mr. J. M. Breed, Big Flats, Chemung county, N. Y.—Are the nutritive qualities of grass materially affected by different degrees of fertility of the soil that produces the grass? Or, to give the question a little different form, suppose two fields, the soil of each by nature as similar as may be, but one of them by manuring and culture

rendered so fertile as to produce from two to three tons of hay per acre; the other, by neglect, so sterile as to produce only from half a ton to one ton of hay per acre (the kinds of grasses in each field the same, say half and half each of timothy and clover), which would be most valuable, a ton of hay grown on the fertile, or on the sterile field?

Mr. N. C. Meeker.—This is an important question, and will bear much discussion. I hope some of our farmers who think on such subjects will report their experience.

Samples of Wheat.

Mr. George Deitz, Chambersburg, Pa., exhibited a fine collection of seed wheat, forty varieties, arranged under glass, which attracted considerable attention.

Device for Washing Potatoes.

Mr. O. H. Cooke, of Morrisville, Vt., showed a neat little device for washing potatoes. It will fit any common water pail, and sells without the pail for twenty-five cents. By turning a crank, the potatoes are rubbed against each other in the water, and made clean without wetting the hands.

Mr. J. A. Whitney thought it a good invention, saving labor, and doing the work well, which is more than many hired girls do. When potatoes are fed to stock, this invention might be applied, for it is not necessary that cattle should eat dirt.

It was generally commended by the club.

Small Fruit Crate and Basket.

Mr. J. K. Parr, Marlboro, N. Y.—The crate had a new hinge and fastening really meritorious. The baskets were so made that all the outside splints ran up and down, and they were neat and durable.

Mr. Solon Robinson said it was good, but not cheap enough. Men wont pay three cents for this basket when they can get one about as good for two. His crate or box for holding berry baskets is good, and has some ideas worthy of general adoption.

Mr. A. S. Fuller.—Round baskets are the best. I prefer the Beecher basket.

Adjourned.

December 1, 1868.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

RHODE ISLAND SWEET CORN.

Mr. J. B. Olcott, Buckland, Hartford county, Conn.—I propose to venture my Rhode Island sweet corn in the market, and would be glad of the good wishes of the Farmers' Club. Out of twenty-nine kinds which I bought and planted last spring, I found none with so many good points as the sort I have sent you for distribution several years. I do not vaunt on its earliness, but this year it came to the table ten weeks after planting, June 6. Of course, this was on warm land and the season was uncommonly rainy. Until lately, my judgment has been entirely disinterested, but I have abundant testimony to confirm my high opinion of it. I shall send it out through the mail at fifty cents, for enough for fifty hills. If there is any better sort I will help bring it out and will furnish $100 premium, if the club will take upon themselves the trouble of awarding it.

The Chair.—This gentleman sent three barrels of his corn to the club in years past, for distribution, and he deserves our thanks.

Mr. N. C. Meeker.—I do not know Mr. Olcott personally, nor am I acquainted with his corn, but while living in Illinois I had some correspondence with him, and I judge him a public spirited man. He wrote about grasses, and expressed a great desire to know the difference between June and blue grass, *poa pretensa* and *poa compressa*, concerning which the Kentucky people are undecided, and botanists give little light. He proposed that sod of the two kinds be sent to the American Institute from various parts of the country, to be rooted when they could be subject to comparison, and a final decision of the question be reached, but I believe nothing came of it. I would move a vote of thanks to Mr. Olcott, and that the club recommend his corn as a valuable variety. Carried.

Dr. Israel Jarvis.—Some people will probably be disappointed because corn changes with the climate.

Mr. W. S. Carpenter.—I have found the best sweet corn to be "Stowell's evergreen." Its ears are very long, and it produces better than any other. But as it comes very late the seed is difficult to be obtained. If I were confined to two varieties of sweet corn I would always wish one of them to be Stowell's.

Remedy for Potato Rot.

Mr. B. L. Lounsbury read a paper on a patented preparation by Mr. Reed, which, from certificates, conveyed the idea that there need be no difficulty in growing potatoes.

Mr. N. C. Meeker.—This is so far from being new that it was brought up before the club more than a year ago, and not much attention was paid to it. The time to consider it is the spring, when some of the preparation should be given to a committee that they may report upon it. If we are to say anything in regard to it, we should first know something about it.

The Chair.—I will name Dr. Hexamer, Mr. Thompson, and Mr. Carpenter, to whom the inventor can present some of his compound, if he chooses, and we will have a report.

Mr. Wm. Lawton.—I do not believe that the potato rot is in the tubers at all; nor do I believe that anybody knows what causes it.

Deep Plowing.

Mr. Horace Greeley read the following paper:

Many controversies result from imperfect definitions. The same words, the same phrases, convey different ideas to the rival disputants. Let me begin, then, by making myself clearly understood. To save time, I will define by negation or exclusion, as follows:

All soils do not require plowing to the same depth; because

1. A large portion of the earth's surface should never be plowed at all. No wet lands should be plowed until thoroughly, permanently drained; plowing them while still wet, or certain to become so after rains, is throwing labor away. A very large area, consisting of swamps, marshes, bogs, fens, sea, lake, river and brook margins or intervales frequently submerged or sodden, should never be plowed until drained or embanked.

2. Then a great proportion of the rocky hillsides or crests, which consist mainly of rocks thinly covered by and often protruding through the soil, should never be plowed, but should be kept always in forest, from which timber is taken from time to time, but never to such extent as to reveal its ruggedness. Westchester county alone has thousands of acres, now denuded and devoted to grazing, which should never have been cleared. Cut off the timber if you are not content with cutting out, but keep such rough land always in wood. Its cultivation can never pay; its grass is burnt up by a sultry week; while stripping it of timber tends to render our springs and streams

scanty and capricious. There is nothing worse in our rural economy than this uncovering of rocky steeps that ought to remain timbered evermore.

3. There are, moreover, lands too sterile to be cultivated with profit, at least while so much good land lies idle and useless. These lands are often level enough, and not too stony; but it will cost more to bring them to a proper state of fertility than they will then be worth. Some of these might be, and probably ought forthwith to be, sowed with nuts and tree-seeds, and so covered with timber; probably the plow might be advantageously used in the process; but it would be unwise to subject them to other culture for ages yet, if ever.

4. Then there are lands which have a good though shallow surface-soil, but covering a poisonous subsoil, which must not be disturbed. Professor Mapes found such a tract in west Jersey, where a stratum of sulphate of iron (copperas) lay but eight inches below the surface. To plow into this, and mix it with the surface-soil, arrested vegetation altogether.

5. And again: There are soils, mainly alluvial, at once so mellow and so fertile that the roots of the cereals, and of most plants, will permeate and draw sustenance from them though they are never disturbed by the plow. I presume the annually flooded intervale of the Nile is of this class. I judge that the valley south of Marysville, California, annually covered many feet deep by the turbid floods of the Yuba, Feather, and American rivers, is much the same. There are portions of the intervale of the Illinois where the muck is sixteen feet deep, very loose and rich. I was told in California that the grape, though it had to be watered sparingly during its first two summers, needed no irrigation thereafter in the valleys of that State, though they are dried up in summer to a depth of several feet. The roots strike down through the rich loam below till they find moisture that they can appropriate and thrive upon. I judge that the valley of the Sacramento and its main tributaries is often parched to a depth of four or five feet.

I have thus fully conceded that deep plowing is not everywhere requisite. Now let me show where and why it is needed:

1. It has been abundantly demonstrated here that the roots of plants are often found at a distance of several feet from the stem. Any of us may have seen that this is as true of Indian corn as of Canada thistles; with a microscope and due patience, the roots of wheat may be traced from four to six feet. Of course, these roots

seek nourishment and find it. Nature, in the broad view, makes no abortive, at least no wanton, effort. Roots wander in search of food not otherwise to be found.

2. Our subsoils are generally compact and repellent. Wherever a ditcher would naturally use a pick, there few roots can make their way, except very slowly and by wasting effort. Few or no cereals or edible roots can feed and flourish on the penetration of such subsoils. And, while our sands and looser gravels are more easily traversed, they seldom contain the plant food whereof the roots are in search. They either remain unpenetrated, or the effort is unrewarded by any gain of nutrition to the plant.

3. Our summers and autumns are often persistently hot and dry. The continuously torrid suns, which, this year, destroyed half the later crops of Europe, are here encountered as often as every third year. Drouth is one of the foremost causes of the failure of our crops. Our ancestors mainly migrated hither from the British isles, from Holland, and the coasts of northern and western Europe, where humidity is the rule, protracted drouth the exception. Sixteen inches of soil in our climate is hardly equal, as an antidote to drouth, to six inches in Ireland or Holland. And yet the best farmers of those countries agree in commending deeper plowing.

4. What we advocate is not the burying of the vegetable mold or natural surface-soil under several inches of cold, lifeless clay, sand, or gravel. If the subsoil is not to be enriched, it may better remain the subsoil; but that does not prove that it ought not to be lifted, stirred, aerated, pulverized. The right thing to do is to enrich as well as mellow and aerate the entire soil to a depth of fully eighteen inches; though twelve may answer, as a beginning. Use a Michigan or a subsoil plow, if you will, and keep the various strata where nature placed them; but give your plants, like your cattle, a chance to reach food and drink at all times. Let down the bars that would keep them from the life-giving springs.

5. Plants look to the soil for 1, anchorage; 2, moisture; 3, most of their food. If they cannot find these more certainly and more abundantly in twelve to eighteen inches of soil than in six, then reason is a fool, mathematics a conjectural science, and a farmer should prefer a balance in bank to his credit of $600 to one of $1,800.

6. We are told that roots prefer to run near the surface, loving the warmth of the sun. Let them run there, then; we do not hinder them. Make the soil rich as well as deep, and let them run near the

surface for warmth, or descend for moisture, or both, as they shall see fit. We proffer them freedom of choice. If a wet season attracts them to the surface, a dry one must constrain them to dive for moisture. It is our duty to provide that they may flourish, however wayward the season.

7. I have a steep hillside, which I choose to cultivate, the soil being warm and kind. Plow this six inches deep, and the first hard shower sweeps its soil by cart-loads into the brook below, where it is useless. Plow it twice as deep, and not a peck of soil will be flooded off in a lifetime.

8. In a wet season deep plowing does, at the worst, no harm; in a dry season, it doubles the crop.

9. Unless a small army is more effective than a large one; an empty pocket-book better than a full one; a lean crop preferable to a large one, then a deep soil must be more productive than a shallow one.

Mr. S. E. Todd.—I am well pleased with this paper, for it tells something which we all wish to know, and I think it will be considered the most valuable paper ever presented to this club.

Some discussion followed on minor points, when Dr. Trimble announced that he had something further to offer on shallow plowing and farming in Salem county, New Jersey, and the whole subject was deferred for three weeks. The importance of a right understanding of the whole subject was conceded, and it is now proposed to go into an extended investigation. Members ought to be prepared with facts.

WILLOW FENCES.

Mr. Hines, of Patchogue, L. I., showed some curious specimens of fence made by lashing and braiding the young shoots of the gray willow. He says a perfect enclosure can be made in three years. The cuttings or scions are planted six inches apart and interlaced as they grow. It is especially convenient for swampy grounds.

WATER-TIGHT SPOUTS AND WATER.

Mr. J. C. Stratton, Woodland, Wabash county, Minnesota.—Can I take rough boards, nail them together, and make a trough that will be water-tight for conveying water from my pump to the house, twenty-six rods distant?

Mr. N. C. Meeker.—The edges of such a trough should be covered with white lead before nailing. A better trough is made from sap-

lings six inches in diameter, split in two. If one is able, galvanized iron pipe run from the well into the house, where the pump should be placed, would be better, though there might be some difficulty in bringing water so far. It would be really cheaper to dig another well close to the house, and have the pipes come up through the floor into the kitchen, the turns being made with cast iron elbows. It is worth not less than fifty dollars a year to have water come into the kitchen, and every farmer who has not such an arrangement, ought to sit on the bars half an hour every day and think about it. Of the new kind of wells made by driving down pipe, this reporter will give particular information when he gets through with the one now under way.

The Gamgee Process.

Mr. C. W. Brinsmade, of Litchfield, Ohio, asks about it, and is answered by

Mr. J. B. Lyman.—The method of Professor Gamgee was invented by his brother, Dr. Arthur Gamgee, of Edinburgh, a thorough chemist. It has been patented in England and the United States. The process consists in placing the meat, as soon as the animal heat is expelled, in a close chamber or cylinder from which the air has been pumped. Then carbonic acid gas is admitted, and the meat remains many hours thus immersed. A very little sulphur, in a gaseous form, is also admitted. The action of these gases is to penetrate the meat, even to the bone, and so fix the ammonia and other volatile parts that decay will not commence for weeks and months. The flesh is not changed in taste or appearance.

Adjourned.

December 8, 1868.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Early Potatoes.

Mr. E. McConnell, of New Castle, Pa.—The seedling potato he exhibited is from the Buckeye, and comes to the table two weeks earlier than the Early Rose.

Mr. W. S. Carpenter.—I have been making experiments with varieties of the potato for many years, and have found but very few of the new sorts worth much. They have some one merit, but lack the quality of keeping well, or they are not productive, or their table

quality is low. The only new potato of great merit is, in my opinion, the Early Rose. It is unsurpassed, and, so far as my experience goes, unequaled.

Mr. Wm. Lawton.—The table qualities of a potato are for me a matter of the first importance. I planted this year three varieties, the Early Goodrich, the Harrison, and the White Mercer. The Harrison produces finely, but for the table I would rather have two bushels of the White Mercer than four of the Harrison. For eating, I know of no potato equal to the White Mercer.

Mr. O. C. Wait, West Georgia, Vt., exhibited some of the Early Rose growing on the stems.

SOWING BARLEY.

Mr. E. Truxton, of Lincoln county, Ohio, asks the club when he should sow barley.

Dr. Isaac P. Trimble.—There was an old rule in Pennsylvania when I was a boy, to sow as early as possible, when first the frost is out of the ground.

Mr. W. S. Carpenter.—That depends on the variety. It is well, of course, for spring barley to be sown early, but I prefer winter barley; it is surer and yields better. I sow my barley as near the 20th of September as the weather will allow.

Mr. J. B. Lyman.—When do you sow fall barley?

Mr. W. S. Carpenter.—On the 20th of September.

REMOVAL OF IRON STAINS FROM GRANITE.

Mr. Thomas Young, Philadelphia, Pa., has a granite front that has been deeply stained with iron rust; he writes asking the chemical men of the club what he shall do about it. He has used sundry acids with but indifferent success.

Mr. James A. Whitney.—The iron rust should be eaten out with several washings of oxalic acid, and this removed with water. Then coat the surface with hydrated silicate of potash, commonly called liquid glass. This will effectually fill the pores and coat the face of the stone.

WHEN LIME SHOULD BE APPLIED.

A gentleman from Essex county, New Jersey, writes:

"Will some of the gentlemen in attendance at the next meeting of the Farmers' Club be so good as to give their advice of the best time and mode of applying lime to the soil? Will it answer to spread it

on the ground recently plowed, and which is now frozen hard, or, on unplowed sod or corn ground while they are frozen during the winter, and perhaps covered with snow? The lime has to be drawn by teams some ten miles, which can only be done during the leisure of winter, and if it can be thrown directly on the land, without loss of any of its properties, it will be a great convenience.

"The ground is part shelly stone, with but thin soil on it, and part clay. A portion lays on a sidehill."

Chair.—As a rule we do not discuss anonymous letters, but as the subject is one of much importance, and true modesty may have induced the gentleman to withhold his name, perhaps some member will give his experience on the winter application of lime.

Mr. William Lawton.—Perhaps the subject is worthy our regard if the writer is irregular in his approach. I do not know as much as some about lime, but my experience is decidedly in favor of putting it on in winter. It is a singular fact that cold water dissolves lime better than warm. The best season for getting a solution of lime into the soil is during the cold spring rains, and when the winter snows melt. It takes 700 parts of cold water to dissolve one of lime. Hence we must have the lime at the surface at the time of the greatest rainfall. It is better to spread it on a frozen surface, because it will become dissolved before it sinks into the soil.

Combing Wool.

Mr. W. M. Brown, Paris, Ontario county, Canada, writes: "There appears to be quite a disposition on the part of the Americans to engage in the production of combing wool, as there has been an unusual export demand for long wool sheep west, into Michigan, Indiana, and Illinois. This enterprise is an exhibition of the principle of political economy, and also the wisdom of a protective policy. We shall be disappointed if the west in a short time is not producing a supply of this class of wool equal to the present demand. But the demand is destined to increase with the advance and extended production of delaine goods, and it is an act of economy for the farmers to anticipate this want and be ready to supply it. The growth of combing wool in England is more the result of the high price of mutton than the price of wool, the production of wool being a result of the great demand and paying prices for mutton sheep. This is the reason why wool is cheap in England, the clip being of secondary importance. The United Kingdom, England,

Ireland and Scotland contained in 1865–6, 25,700,000 sheep, their total number of square miles being 115,686; less by 11,000 than Illinois and Missouri. The only remedy for cheap wool and mutton is for farmers to form joint stock companies, and establish woolen factories, manufacture their own cloths, and thereby make an effort to consume their mutton at home on the prairies, instead of paying freight and commission on their stock east and paying a heavy commission and transportation on their manufactured goods. Establish a factory or two in every county, shares of $100 each or more, according to the capitalists of the section. There would be very little cash required to run the establishment, as the farmers could raise their own wool, and in return could become good customers, and defy opposition, as self-interest would induce them to consume the product of their own manufactures. There are strong inducements to a move of this kind, a high tariff, cheap wool, cheap mutton, low price of breadstuffs, and high priced woolen goods. There was an argument used recently by one of our largest woolen manufacturers in Canada against a *high tariff*. It was that such a tariff gave inducements to every one to engage in manufactures, and the consequence was a strong home competition, which reduced the profits. He was in favor of low tariff. Then only large capitalists could engage in the business and make a profit. We are in the hands of large manufacturers in Canada, and have been for a long time, but the sun will rise *even here* after awhile."

Mr. J. B. Lyman.—Our friend from Canada is somewhat in error in supposing that the establishment of factories in certain localities will do much to regulate the wool market. It would have been true thirty years ago. But steam has done much to change all that. As a rule, fine wools will be produced on remote and cheap lands, while rich sections, near cities and railroads, will do better with sheep, whose mutton has fine flavor, which fatten easily, and yield an inferior fleece. Manufactories will no longer go where the raw material is produced, and it will be of little use for farmers to unite in an effort to establish little woolen mills in order to coerce large capitalists. In such a contest the few rich men will outwit the many operating with small sums. In Ontario county the true policy will be to produce *mutton*, and leave fineness of fleece to remoter regions.

Hops and Hop-Poles.

Mr. Warren Ferris, East Worcester, Otsego county, N. Y., writes about the hop, and recommends the plan or patent of Olindorf for

training the vines. One pole to the hill, he says, is my mode of training, and no twine, with two vines to the pole. That gives air and sun to the hops. Thick foliage, wet weather, a sheltered position, and barn-yard manures, bring lice and blue-mould to hops. You want to give all the air and sunshine possible. Olindorf's plan does this.

Mr. James A. Whitney.—Mr. Chairman: Twenty or thirty years ago hop-poles were plenty and comparatively cheap in the section mentioned, but within a few years past poles have become very expensive, and twine is extensively used as a substitute. The Collins' yard was one of the very first twine, and very good crops have been grown with it. The notion that it harbors the vermin is not in accordance with my own experience, for some of the best hops I ever saw were on strung yards, while some that were infested with lice the worst were on the old-fashioned poles. There are very few hop-growers that would be willing to get along with but one pole to the hill.

Deep Plowing in Otsego.

Mr. Ferris also gives his experience in deep plowing. He says: western New York has had some experience in winter wheat and clover, and those farmers plow deep in the heat of the summer for those crops. I have dug up and manured red clover roots over four feet long that grew in made soil. Two years ago I set out a young orchard, and the same spring seeded it to timothy and clover. The ground had been plowed five inches deep; but around the trees I spaded the soil two feet to give the young trees a start. Last summer I mowed the grass, and around the trees where it had been worked to a depth of two feet, the timothy heads were twelve inches long—straw and head five feet—while two feet distant the grass was not more than half as large. The subsoil was gravely loam, descending to the south. I find I can make an almost worn out soil produce a good crop of potatoes or hops by deep plowing. He goes on to say that late plowing is bad, and such work should be done only in mid-summer.

Mr. William Lawton.—On clay lands I am persuaded that fall plowing is not only safe, but a manifest advantage. The frost is a great subduer of soils; and a stiff clay, after being exposed for a winter, is greatly improved.

Mr. James A. Whitney.—I have, within ten miles of the village of

East Worcester, plowed a light upland loam ten inches deep, with first rate results. Except on some of the alluvial flats along Cherry Valley creek, there is very little land in Otsego county but would be the better for deep tillage.

Migration Southward.

Mr. Alfred B. Zerega, writes the club a long letter from Loudon county, Va., saying that the club is wrong in discouraging migration south except by colonies. He says that what Loudon county and all Virginia want is Yankee enterprise and Yankee ingenuity. He was a Union officer in the war, and commanded a gunboat, has ever and in all companies denounced slavery, but finds no prejudice against him on that account, and no disposition to refer to the past.

Dr. J. V. C. Smith.—I know this gentleman well. He has wealth and intelligence, and what is more he has a generous heart. He will take by the hand all northern men who go to settle near him. I shall be happy to give letters of introduction to this correspondent to any of my friends who propose to settle in that part of Virginia.

Mr. N. C. Meeker.—One error is hinted in this letter from Virginia, on which I would say a word. He concludes that Loudon is a splendid grape county because the native vines are very large. That is no sign at all. As a general thing there are more wild grape vines in valleys than on the hills. But that does not prove that vineyards should be in the valleys. A big vine does not always yield a superior grape.

Dr. J. E. Snodgrass.—Loudon was of old one of the best counties of Virginia. A great many Germans and Quakers settled there, they were anti-slavery, and their part of the county was the best. There is much rich, strong land there. But I think the gentleman is a little in error about the temper of those old planters.

Fine Table Grapes.

Several boxes of them were distributed to the club by Mr. C. W. Idell, of West Washington Market. The best were Isabellas. They cling longer to the cluster. His Catawbas did not market so well this year, many of them were not entirely ripe.

Dr. Isaac P. Trimble.—Last year I was at the Knox Vineyard, Pittsburg, Pa., and saw thirty acres covered with a crop estimated at 160 tons. They were mostly Concords.

Mr. W. S. Carpenter.—We have no finer grape than the Catawba, if it ripens. Those from Kelly's Island and the south shore of Lake Erie are unequaled in America.

American Champagne.

A case of champagne from Brocton, Chautauqua county, N. Y., was opened and given out by J. B. Lyman. A committee of twelve was appointed and instructed to test each a quart bottle and report next week upon the flavor and other qualities of the wine. The following paper was prepared by a friend of the gentleman who sends this champagne, and read by Mr. Lyman:

The sample of wine furnished is from Messrs. Ryckman, Day & Co., Brocton, Chautauqua county, N. Y. Brocton, at the present time, is becoming one of the most important centers of grape culture and wine manufacture in the country. It is situated on the Buffalo and Erie road, eight miles from Dunkirk, and at the junction of the Buffalo, Corry and Pittsburg railroad. The first vineyard was planted upon the shores of the lake in that region forty-four years ago, with a few Isabella and a few Catawba vines, and the original vines are still in successful bearing. The uniform success which attended the raising of grapes in the original vineyard led others, twenty years since, to undertake the culture, and from year to year the amount of land devoted to the planting of vines has been increasing. At the present time, between Fredonia on the east and Weitfield on the west, a distance of fifteen miles, there are probably over a thousand acres of vines in bearing, and as much more planted which will be in bearing in a year or two. The great majority of vineyards are planted with the Isabella grape. The Catawba forms the greater portion of the residue, though the Delaware has, within the past three years, been extensively planted, and now the Iona is becoming a marked favorite for wine. The Clinton is also increasing in favor every year by reason of its value in the manufacture of red wines. The success which attends the culture of the grape in Chautauqua county is to be ascribed to the proximity of the vineyards to the lake, the atmosphere of which makes the climate more equable, keeps back vegetation in the spring and early frosts in the fall, so that the frost seldom interferes with the maturing of the fruit. The manufacture of wine at Brocton was commenced several years since by the Hon. J. B. Fay, and was successfully pursued until the organization of the Lake Shore Wine Company, which erected large buildings and cellars for the manufacture of wine on an extensive scale and succeeded Mr. Fay in his operations. Messrs. Ryckman, Day & Co., are the lessees of the property

from the Lake Shore Wine Company, and have continued the manufacture. The cellars of the company have a capacity for storing nearly 200,000 gallons of wine, and the amount manufactured so far has varied from 15,000 to 30,000 gallons annually. The varieties manufactured consist of three brands of sparkling wines, the "Honeymoon," the "Diamond Wedding," and "Sparkling Catawba." In all these varieties the juice of the Isabella forms a considerable portion of the wine, other varieties being mixed with it with a view of varying the flavors. The only sugar used is that which is always employed in the manufacture of sparkling wines to evolve the carbonic acid gas. Of the other varieties they manufacture Still Catawba, Sweet Catawba, Red Clinton, Still Isabella, Red Isabella and Sweet Isabella.

The present year they have also considerable wine from the Delaware grape. They have a home market in western New York, Pennsylvania and Ohio for all the wine they have thus far been able to manufacture, but are making preparations to enlarge their operations.

The average consumption of grapes in wine-making is twelve pounds to a gallon. The price which a pint of this wine commands is seventy-five cents. Thus a pound of grapes made into wine, with the glass containing it, brings the wine maker two dollars. For lands and climates suited to grape growing, what other crop is so profitable?

NEW MODE OF PREVENTING DECAY IN WOOD.

The preservation of farm implements was discussed at length in a paper read by a gentleman interested in a valuable discovery. He says:

There is probably no branch of industry in this country in which, wealth, enterprise, and genius are more successfully employed than in the manufacture of agricultural implements. The very best timber is selected for this purpose, and much time and labor expended in its preparation; yet, after all, the wood work of these implements lasts but a few years; however well it may be seasoned by the ordinary process, it is liable to destruction by dry rot and powder post. Exposure to the alternations of temperature and moisture, if it do not produce immediate decay, will cause checking and otherwise destroy the vitality and elasticity, and thus produce brittleness of fibre.

Indeed the strength of the wood is not unfrequently impaired in its preparation for use. By many, the wood is soaked in water prior to drying; the albumen is thus dissolved, and by the application of heat, natural or artificial, the solution is driven out; the loss of the

albumen, which is part of its life and strength, renders the wood more porous and of course more susceptible to the absorption of moisture. There are also many manufacturers, who, unable and unwilling to wait for the slow process of desiccation by exposure of their lumber to the open air for several years, resort to the more speedy method of *kiln drying.* They place their green wood in a chamber and subject it for weeks and months to hot air or superheated steam. This is but one mode of distillation, driving out the life and strength of the wood at every step, and if continued will result in complete destruction of the fibre. A piece of charcoal is a specimen of wood too much seasoned by the kiln-drying process. But whether dried in a kiln or in the open air, wood remains porous, and will absorb moisture, and hence is liable to shrink and swell according to its exposure.

There is a mode of treatment, however, lately brought to the attention of the public, whereby green wood, fresh from the forest, may be shaped and fitted, and in a few hours so prepared that it can be used in the manufacture of implements; this is a recent American invention and called the "Robbins process." This process is so simple and so easy of application that it deserves a brief explanation. The wood to be treated is placed in an iron chamber; connected with this by a pipe or goose neck is a still, supplied with coal tar and under which heat is applied for its distillation. At from 250 to 300 degrees the vapor of naphtha is generated. which passes over into the wood chamber. This hot vapor drives the air out of the chamber and expels the moisture from the wood. It coagulates the albumen of the sap, as the white of an egg is coagulated, made tough and insoluble by the action of boiling water.

The air driven out, the moisture expelled, the albumen coagulated, and the pores of the wood thus being made void and expanded, the heat under the still is increased to from 365 to 400 degrees. At this temperature the vapor of creosote (or carbolic acid), is generated and passes into the chamber, and thus the wood is subjected to a second bath, in an element so subtile that it becomes thoroughly permeated with it. This creosote or carbolic acid is a powerful antiseptic, and will effectually prevent fermentation or putrefaction of the albumen, or, in other words, prevent *dry rot.* It *cures* the wood, as a ham is cured, by smoke; it *tans* it, as a hide is tanned, with tannic acid. But merely to drive out the moisture, coagulate the albumen, and supply the wood with an antiseptic, is not all

that is necessary; the fibre must also be protected. By increasing the heat under the still to from 500 to 600 degrees the vapors of the heavy tar oils are carried into the chamber, and the wood is thus subjected to a third bath in the vapor of oils. This condenses in the wood, primes it thoroughly, and furnishes to the fibrous portion of it complete protection against the moisture of the atmosphere. By this treatment the wood undergoes no change in shape or size, and is at once ready to be fitted and applied to the purposes intended. There is as much put into the wood as was driven out, hence it does not shrink, and, not shrinking, it cannot warp or check.

Thus the wood is not only seasoned, or cured, so that it will not shrink, warp or check, but by coagulating the albumen and filling the pores with the oil (which becomes resinous in contact with the atmosphere) the wood is made denser, tougher, and stronger. Upon actual test, it has been shown that the strength of white pine, for instance, was increased thirty-seven per cent by the treatment. By this process the wood is also preserved from decay. Decomposition in either animal or vegetable substances cannot take place in the presence of creosote. The wood is also thoroughly primed, and no paint is necessary to the protection of the fibre, but may be put on merely by way of ornament. In such case less oil will answer, inasmuch as the wood is already saturated with oil. The value of this process in the treatment of wood used in agricultural implements is very great, but not to be compared to its value in the preparation of fencing materials, especially in those portions of the country where the people have to use sawed lumber obtained from a distance; planks and posts prepared by the "Robbins process," and properly set, will last for centuries. What shall be said of the value of this preservative process, in its application to buildings? It is said that the dwellings of 25,000,000 of the people of this country are chiefly made of wood. Nearly all the outbuildings upon our farms are made of such perishable material, especially the shingles so generally used for roofs. No reliable estimate can ever be formed of the loss by decay of the wood used in dwellings, out-buildings and fences. Another important application of this invention may be made by horticulturists. In many portions of the country the grape is extensively cultivated, and an immense amount of lumber is used in trellis for the vines. These supports rot in a very short time, because that portion which is not inserted in the ground is almost constantly shaded. If constructed of wood treated by the "Robbins

process," they will not only not decay, but, being saturated with creosote, they will have the effect of repelling all insects. But there is still another use for this invention of Robbins' in which the farmer is deeply interested. The effect of the vapors of coal tar upon the hubs and spokes and felloes of wheels is wonderful. Timber may be cut from the forest on one day and on the next turned into hubs and spokes, and after a few hours of treatment can be fashioned into a wheel. There being no shrinking, the joints will all fit. The spokes will be strengthened, and the hubs will never shrink or swell, and consequently will never check in the slightest. The farmers cannot fail to appreciate the value of a process susceptible of such universal application, and by machinery, simple and inexpensive, which will not only season wood and lumber in a few hours, but also give it additional strength, and at the same time prime it and preserve it from mould and decay, and from destruction by insects. It has been suggested by a practical farmer that, as carbolic acid destroys the cause of putrification, and has been used with great success in England, Belgium and Holland, during the prevalence of cholera and of the cattle plague, it would be well to have all the wood work of stables and barns saturated with this substance.

He also suggests the use of blocks of wood similar to those employed in the Nicholson pavement, for laying the floors of stalls for cattle and horses, and to have those blocks treated by the "Robbin's process," and thoroughly saturated with carbolic acid. This substance would not only preserve the flooring thus laid, but have a tendency to keep off diseases and drive away the flies.

Mr. J. B. Lyman.—The gentleman has made the operation of his process quite clear. No doubt it is of much value in the mechanic arts, but I would inquire of the gentleman just how the farmer is to be benefited by it.

Reply.—A chamber and retort can be erected at a cost of $600, which would do all the wood preserving for a neighborhood. The cost of treating a post would be five cents, and the duration of the post would be two or three or four times as long. Tools thus treated would want no paint and require no care or housing. Wagon and cart wheels would never check or rot, and shingles thus treated would be as durable as slate, and very much cheaper and more conveniently applied.

DESICCATING THE SWEET POTATO.

Mr. Jackson Warner, late of Natchez, Miss., was introduced and showed specimens of dried sweet potato, remarkably white and handsome. They may be dried by hot air or super-heated steam. They dry up to one-third, one bushel of dry coming out from three of green potatoes put in. The roots are peeled and sliced before going into the kiln. The cost, he thinks, would not be over two cents a bushel; and may be landed in the New York market for five dollars, and allow the planter a fair profit on his crop. The cost of a kiln is from fifty dollars to $200, according to size. A fifty dollar kiln will dry twelve bushels a day. The temperature necessary is from 150 to 175 degrees, Fahrenheit. Cool air is admitted at intervals to repel the moisture. This also keeps the color clear and good. Cotton is no longer king; but the potato may be when the planters learn how to prepare them for distant markets.

Mr. James A. Whitney.—Mr. Chairman, I consider this one of the most important subjects that has been brought to the notice of this club for a long time past. The desiccation of vegetables has been a subject of experiment for a number of years, especially in England, and for army and navy supply. One of the most efficient processes was employed in preparing turnips, carrots, cabbages, and similar perishable vegetables. In this the substances were first deprived, by drying, of about seven or eight per cent of natural moisture, and then subjected to enormous pressure by hydraulic power. By this means many hundred weight could be brought within the space of a cubic yard; but the method was very expensive, owing to the great cost of the apparatus required. The sweet potato can be dried by the action of hot air in kilns that need but little care; and if the immense quantities grown in the South can be converted into a cheap substitute for flour it will prove a blessing to the thousands who inhabit our tenement houses, for no greater benefit can be conferred on the community than to make bread cheap. I think it quite possible that other vegetables might be prepared in the same manner with good results. People have tried to desiccate the common potato, but it is difficult to keep it from turning black in drying. I hope the subject of preparing the sweet potato in this way will receive the attention it so much deserves.

Mr. Solon Robinson.—This process is evidently of great value to the farmer; the other, as clearly, is of little or no use to him. Will

not Mr. Whitney look into this matter and prepare a paper or give a verbal report of his investigation?

Mr. James A. Whitney.—I will, cheerfully, if I may be allowed the necessary time for it. I have a number of important analyses now on hand, and when they are completed will take up the sweet potato.

A Valedictory.

Mr. Solon Robinson.—Mr. Chairman and Gentlemen of the Farmers' Club, I have stepped in for a moment to say that for a number of months I may not have the pleasure of meeting with you. Life is always uncertain, and especially so when one has reached the downhill slope of a laborious career. If anything will prolong my years it will be the mellow and balmy air of that shore to which I go. The climate of Florida is, *I know*, the most delightful of any in this country, and I do not believe it is surpassed by the air of Italy, or of any ocean islands. Though distant I shall often think of you; for if there is any act or service in my life in which I have taken pleasure, it is in watching the growth of this organization. Once it was a sapling not so thick as my thumb; now it is a well-grown oak.

Mr. W. S. Carpenter.—May we not hope to hear from you during your sojourn in Florida?

Mr. Solon Robinson.—Yes, gentlemen, I will write you, and report fully the attractions and advantages of that region, and in May I hope to be with you again.

Peaches in Northern Michigan.

Mr. E. P. Avery, of Old Mission, Grand Traverse, writes that in his region peaches have been grown with success along the lake shore for twelve years past, the climate being so mild that dahlias were in bloom on the second day of November. He does not think, however, that any but the more hardy kinds of fruits could be raised at a distance of twenty miles from the shore.

Mr. N. C. Meeker.—The climate is always milder in the immediate neighborhood of great bodies of water than in inland regions under the same lines of latitude, and in all probability the Grand Traverse district is no exception to the rule, although grapes have been killed by the cold at New Mission, not more than a mile from Old Mission. Peaches are grown in large quantities and of fine quality at Dundas, Canada West, under conditions of climate and locality very simliar to those of the Michigan lake shore.

CANE AND CORN IN FLORIDA.

Mr. J. D. Mitchell, near Smyrna, states that within fifty miles of the above place the soil along the lagoons is a rich, sandy loam, from one to six feet deep, and rests upon a sub-stratum of coarse shells. The cane, if allowed to grow for twelve or fourteen months, so that it may have two growths to attain its size, will often reach two inches in diameter. One farmer has taken the tenth crop from the same roots, and that with no cultivation. This perfectly matured cane he says will make the finest quality of sugar and syrup. The same correspondent says that upon the soil where the shells come to the surface, the corn sometimes grows fifteen feet high, although this is not, properly speaking, a corn country. He promises to report at some future time the results of one and a half acres planted to cane, and of 2,500 orange buds set out.

CHICCORY.

Mr. D. C. Dalsey, Chicago, Ill., asks whether chiccory cannot be grown to advantage in this country.

Mr. N. C. Meeker.—The use of chiccory is simply to adulterate coffee, sometimes by the consumer for the sake of economy, and sometimes by the dealer for the sake of dishonest profit. It is used in England and France much more extensively than in this country, but it may be easily raised here by any one who considers it worth while. The roots are cultivated very much in the same manner as carrots, cut into pieces about half an inch square, and thoroughly dried. After this they are roasted like coffee and ground up with a portion of the pure article. We do not favor the use of chiccory in coffee because it possesses no beneficial properties, but on the contrary is said to have a tendency to taint the blood with bad humors. Certainly it impedes digestion.

Adjourned.

December 15, 1868.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

NAMING OF SWEET CORN.

Mr. Joseph B. Olcott of Buckland, Connecticut, asks the privilege of naming his corn the "Farmers' Club." The club by vote, decided that Mr. Olcott could not adopt a name more appropriate or significant than that of the originator, and they advise him to call his excellent variety "Olcott's sweet."

Mr. W. S. Carpenter.—This action it seems to me is proper. The corn of Mr. Olcott is as good perhaps as any, but by giving it our name it seems like a special indorsement which we do not wish to give to the exclusion of others which are not inferior.

Milk Racks.

Mr. E. V. W. Dox, Wilson, Niagara county, N. Y., writes that he has tried, with great satisfaction, an improved milk shelf which was described some time since at one of the meetings of the Farmers' Club. This shelf is made by taking four-inch scantling, setting them upright, and nailing strips of lath to the sides to support the milk-pans. He found this to make an excellent milk rack, but was annoyed by the rats that climbed up to the milk. They were effectually circumvented by placing the foot of each scantling in a short piece of stove pipe; and now, when the dairy season is over, the rack serves to hold his pumpkins and squashes high and dry away from the damp floor, which would lead to their premature decay.

Cleanliness in Stalls.

The same writer also discusses the best way of keeping the flanks and udders of cows free of stable filth. He has succeeded in doing this by raising the animal on a platform of three or four inches in height, and fixing a sloping plank just in front of its fore feet. By thus forcing the animal to keep its hind legs on the edge of the platform, a clean, dry bed is insured, and the udder does not require washing.

Mr. J. B. Lyman.—I notice that all good farmers are, like Mr. Dox, always studying the well-being of their farm stock. If a man lacks the sagacity, to say nothing of the humanity, for attending to the comfort of all his farm animals, he lacks the first requisite of a successful farmer. Stable arrangements should have two ends in view; to save all the droppings, and so dispose of them as to keep the animal entirely free from filth and discomfort. Careful dairymen have a boy who goes along behind the animals with a hoe several times a day raking back the droppings. Short elevated stands, such as Mr. Dox describes, are good inventions, and where the length is adapted to the size of the animal, remarkable cleanliness can be secured. But it is as important to deodorize stable matter as to keep the animals out of it. This is best done by throwing three or four shovels of dry muck behind each animal. A concrete or tar and pebble floor is the best for cows, but unsuited to horses.

Forest Tree Culture.

Mr. J. Greenleaf, Charlestown, Ohio, writing for information concerning the cultivation of chestnut trees, says: I have a piece of natural chestnut land, which is too stony to cultivate, excepting at a good deal of expense. I have tried two or three times to start chestnut trees from the nut, but have as often failed. I would like to know the best time to plant, and mode of cultivating the first two years.

Mr. D. B. Bruen.— Great care must be taken of the seed, in order to insure its germination when planted. If once suffered to become very dry they will not grow. I consider it the best plan to put them under a covering of earth, and then lay a board over the place.

Mr. A. S. Fuller.—I would put them in sand two or three feet below the surface, just as I would so many peach pits. In the spring plant the nuts in rows three or four feet apart, and four or five inches apart in the rows. When they come up, cultivate the young plants very much as you would corn. The next spring they will be ready to transplant. In order to do this successfully, about half of the tap-root should be cut off. This will cause the tree to throw out a multitude of roots near the surface, where they can draw the most nutriment from the soil. This cutting off the tap root will be found of great advantage in transplanting any kind of forest trees.

Mr. Wm. Lawton.—In this connection I would recommend the horse-chestnut, quite a different tree from the ordinary chestnut that we have been talking about, but much more easily raised from the seed. I have derived great advantage, in growing trees of all kinds, in placing a few flat stones upon the soil around the trees. The stones act as a mulch to keep the ground moist and promote the growth of the trees. I have seen very beneficial results from this plan. For instance, in the light soil near Nahant, where peaches do not generally do well, I have seen peach trees kept strong and thrifty by thus rudely paving the ground over their roots. It is also an excellent plan with plantations of small trees.

Another correspondent, Mr. S. Blodgett, of Union, Cass county, Nebraska, says, regarding the raising of forest trees in that region: "What we lack here, in Nebraska, more than anything else is trees. There is no denying that timber is scarce, with a prospect of being scarcer. It seems to me that the people should be waked up to the importance of providing for the future. They should also be taught

the best kinds of trees to grow, and the most profitable manner of growing them. One year ago I sent east for some white pine seed, and planted it in the fall, covering slightly, on well prepared soil; but I have never known that one came up. Whether the grasshoppers destroyed them as fast as they appeared, or whether there was a fault in the planting, I do not know. Perhaps some of the club can tell me. I would like a description of the seed of the European larch and the best manner of starting it."

Mr. W. S. Carpenter.—It has been found almost impossible to grow any of the coniferæ in this latitude, owing to the comparatively intense heat of the sun, which kills the young shrubs the first season. There is no trouble after the first season. The mode most likely to succeed is to sow the ground with oats or rye, which will shade the young or tender trees, and protect them from the sun. The European larch, however, is a deciduous tree, and these remarks do not apply to it.

Dr. J. E. Snodgrass showed a few specimens of chinquepin, from Maryland, and Mr. Fuller expressed the opinion that it would not grow north of New York city. It is a kind of dwarf chestnut, with one nut in a burr, instead of three.

Mr. Nathaniel Pierce, Pawling, Dutchess county, N. Y., sends the club leaves and twigs of a shrub for which he wants a name, describing its berries and leaves.

Mr. A. S. Fuller.—This is the *cellis occidentalis*, or American nettle tree. If it reached any size the wood would be quite valuable for cabinet work, but it grows very slowly, and is of little worth.

Gypsum.

Mr. E. L. Holms, Downsville, Delaware county, N. Y., asks will it pay to use plaster on any kind of land or crop at a cost of twenty or twenty-five dollars per ton, or to use lime in any way on land at a cost of three dollars per barrel? If not, at what price will either of them, or both, be profitable to use in farming?

Mr. Jas. A. Whitney.—Where there are dry upland fields which are difficult of access with heavy loads of barn-yard manure, it will pay to use plaster, even at twenty five dollars a ton. It will not pay to apply lime to land at three dollars a barrel, except in extremely rare cases. The money will be expended to much better advantage in first-class under-draining, and then using a comparatively small quantity of lime on the soil.

Dr. Isaac P. Trimble.—I understand, then, that you would apply the plaster on the dry uplands, as, for instance, where clover is adapted for growth, and the lime you would put on the damp, low-lying soil.

Mr. James A. Whitney.—Yes, lime in its operation on damp soils is, to some extent, a substitute for drainage, and lime and drainage together will convert our swamps into the best farming lands we have. Lime is not, properly speaking, a manure. If fifty bushels are spread upon an acre, the quantity of lime removed in ten successive crops may not be two bushels. It operates not by furnishing plant-food directly, but by taming and sweetening a wild and sour soil, fitting it to be the seed-bed of the most useful plants.

YOKING OXEN.

Mr. Pierce, in the same letter, speaks of a discussion had at a former meeting of the club, about the common ox yoke, which some of the members had stigmatized as "a relic of barbarism." He prefers the ordinary yoke to all other devices, and says that if properly made it will cause less pain to the animal.

Mr. W. S. Carpenter.—There is no danger of chafing the shoulders of oxen unless they are worked in wet weather.

Mr. S. Edwards Todd.—I have made cat yokes, calf yokes, and ox yokes, and my long experience in the use of oxen warrants me in saying that oxen will work more easily and perform more service when wearing the old-fashioned Connecticut yoke, if it be correctly made and properly fitted to the neck of the oxen. I have seen illustrations of yokes in some of our agricultural papers, attached to the heads instead of the necks and shoulders. To show that the old way is the best, let a man attempt to lift a heavy weight with a handspike on his shoulder, or resting on his head, and he will perceive at once whether an ox can draw most with a yoke attached to his head or to his neck.

FISH MANURE.

Mr. H. Hammond, Augusta, Georgia, writes: "I would be glad to have the opinion of the club on the value of 'fish guano' as a fertilizer, as compared with genuine Peruvian guano. The ease with which it can be handled and transported to a distance (as for instance to Georgia or South Carolina) being taken into consideration."

Mr. James A. Whitney.—The so-called fish guano is simply the refuse of the fish called moss bunkers, after they have had the oil squeezed out of them in strong presses. The bones of the fish of course contain much phosphoric acid, and the flesh in decomposing generates ammonia. It is as good, to say the least, as the average guano.

Mr. W. S. Carpenter.—I am very much in favor of this manure. It is commonly sold for from twenty dollars to twenty-four dollars per ton. It acts quickly and is more lasting in its effect than guano. It is not put up in as good condition as it ought so be, but it can be handled very well with a spade. It may also be mixed with dry earth, and is a cheap manure at thirty dollars per ton.

Report on American Champagne.

The chair read the following as the report of members of the committee on American wines, appointed at the meeting of the previous week:

"As to the bottle-sparkling wine from Ryckman, Day & Co., 'Lake Shore vineyard,' Chautauqua county, N. Y., I have to say I invited some others to test or taste its qualities, two of them being good judges, and they and myself call it a fine quality of wine, much better than most of the imported. We thought, however, that it was not dry enough, or, in other words, *too sweet* to suit the taste of most gentlemen."

J. V. C. Smith and others who had tested the wine, expressed their concurrence in the favorable opinion expressed by the chairman.

The Nature and Uses of the Roots of Vegetables.

Mr. S. Edward Todd.—Most persons are apt to think that a root is nothing but an under ground portion of a tree, or growing plant, pushed out of the kernel through the soil, as one would thrust a walking stick into a sand-bank; and judging from the manner in which roots are crushed, mutilated and torn, when a tree or plant is removed, one would suppose that roots are of no more account than numerous wooden pegs thrust in every direction from the parent stem, to aid the growing plant in maintaining an erect position. But to the practical cultivator of the soil, a correct understanding and proper application of the particular functions of roots; how they are formed; how they ramify through the soil; how they change the lifeless clods into fine mould; how they maintain the life of the growing plant,

and how they build up the parent stem and aid in unfolding the buds and in developing the leaves and fruits, constitute one of the most useful and important branches of practical agriculture. The tiller of the soil who does not understand something of the office of roots *may*, by accident succeed. A correct understanding of the functions of growing plants and their roots is fundamental to a mastery of the principles upon which sound agriculture depends. Roots are things of life. Vegetable life is as real and important as animal life; and the little white rootlets, no bigger than a knitting needle, that push their obscure way through the dim and turbid soil, are as much alive as earth worms or grubs, or the insects that burrow under the sod. The philosophy of vegetable economy in the soil is mysterious. It cannot be studied, because when we invade those dim and silent kingdoms with the scrutiny of our science, this very intrusion arrests the living process we would study. When a certain amount of moisture and heat have entered the seed, the germ, quickened into life, pushes out a root, which always precedes the stem. As soon as the radicle has burst through the integument of the kernel the tender extremity is provided with a portion of a radicle of a soft texture, which the botanists call a spongiole or little sponge, because its chief duty is to absorb water that has been enriched by taking into solution portions of plant food. These little roots are provided with a cap or tip much harder than the body of the spongiole, somewhat as the feet of the mole or woodchuck are armed with nails. This cap is perforated with numerous small holes, large enough to admit such liquid as the spongiole might require to lengthen the root by adding particle to atom behind this shield as the elongation of each root is affected. This cap on the extremity of the root may also be compared to a mole-plow, which is thrust forward through the seed-lid as fast as material is accumulated to construct the body of the root, just as a mason forms a culvert or cement water pipe by building on brick after brick, or by continuing to apply more and more mortar at one end of his work. Here, at the extremity of the root, is where its growth, lengthways, takes place. And here also, behind this indurated cap is the *stomach*, so to speak, of the root. The pabulum is received into the spongiole, digested, to all intents and purposes, just as much as the food that enters the stomach of a living animal. Here it is concocted into sap and fibrous material; and by a process which mortals are not permitted to look into; as all this occurs in darkness, the hard cap, or point of the miniature mole

plow, is thrust forward, farther and farther from the parent stem. In this way, rootlets and branch rootless, and multiple rootlets, continue to be formed, until every cubic inch of the low seed bed has been provided with a score of open mouths ready to lay hold of any material that may be in the soil, and which is adapted to the requirements of the growing plant. The spongioles of certain kinds of plants will lay hold of course, hard, and rough materials, and appropriate them to the purposes of the plant, just as goats will subsist on weeds and other rough feed which sheep would refuse. Roots benefit the soil in two ways, by their action in life and their function after death. Thus, clover and the thistle roots pierce a stiff subsoil and by capillary attraction draw up potash, lime, iron, and phosphorus in solution. When the plant dies these substances are nearer the surface than they were before, while the decay of the root yields humus. How to promote growth of roots is a consideration of the greatest practical importance to every person who trains a growing vine, or cultivates a tiny flower. The vital fluid, which is to trees and plants what blood is to the animal system, enters the circulation through the spongioles of the innumerable radicles which are sent out in quest of such material as the plant requires, to build up the stem and branches, and to develop the fruit. If the earth, therefore, be in such a fine state of pulverization that the tender radicles can spread readily, in every direction, several feet below the surface, the requirements of the growing roots, in a very important respect, will have been met. In many localities nature has done all that any tree or plant may require, as the entire earth, as far down as roots will ever strike, even were they to descend as far as the stem pushes upward, is so porous, mellow and fertile that the tender radicles meet with very little resistance. Such land will require no breaking up with the subsoil plow or spade. On the contrary, where the strata of earth beneath the surface mould is so indurated and stubborn that in dry weather a spade cannot be thrust into it with one effort of the foot, there the trench plow, the subsoiler, the spade, the pick and the clod crusher should all be brought into requisition, in preparing the bed for the penetration of the countless radicles that must spring into life, before our palates can be regaled with the wheaten loaf or the luscious fruit. The delicate radicles of fruit-producing plants and trees cannot feed on coarse and rough material. The roots of such plants as are cultivated for the food they yield, cannot appropriate lumps of earth to the development of the stem and fruit, any more than a bullock,

when confined to a straw stack, can lay on the excellent steak, or the delicate tenderloin. Every minute atom for the nourishment of plants must be changed from a solid to a liquid condition, and be brought in contact with the spongioles at the extremities of the radicles, which cannot leave their places to go after one drop of nourishment, but they must remain stationary with mouths ever open to catch the minute particles as they are washed downward by the descending rain drops. Therefore, the finer the coarse fertilizing material can be reduced, and the more thoroughly the seed-bed can be comminuted before the germs are planted in the mould, the more readily will the roots perform their office of building up strong and healthful stems, and of developing abundant crops.

Southern California.

W. W. Rumford, of Tulare Co., Cal.—Can the Farmers' Club give any information about orange trees? The general idea seems to be that an orange is about the same thing the world over. Yet we hear of sweet oranges and sour oranges; some have thick skins and others thin, and there is considerable difference in the size, but still they have no distinctive names such as are applied to our northern fruits. The seedlings that I have seen here are very slow coming into bearing, and the fruit inferior. Now, if there are superior varieties that have names I would like to be made acquainted with them, and put in the way of obtaining buds or grafts. The same may be said of the lemon, and I am equally anxious to become acquainted with the best varieties of that fruit. I think that certain portions of this valley will be found perfectly adapted to semi-tropical fruits, and I am about to give them a trial. I shall keep a daily record of temperature, direction and force of wind, and amount of rain, and if any of your subscribers wish information about the country I will be glad to furnish it. We have thousands of acres of as good wheat land as any in the State, open to pre-emption or homestead, and there are plenty of locations now within three miles of town where we have good stores, post-office, telegraph office, and express office; also, good schools and churches. The soil of the plains is mostly a dark clay loam, from two to three feet deep; but there are places where it changes to a sandy loam, and even a loose sand. My weather record for the half month of November is as follows: Highest temperature, 80 deg.; lowest, 37 deg.; mean, 56.70 deg.; fair days, eleven; variable, one; stormy, two; direction of wind about equally distributed

around the compass; force of wind, light air or gentle breeze, frequently calm. The rain wet the ground about three inches deep, and grass is now an inch high. Would you like a monthly report such as this, with a few observations on the forwardness of grains, vegetables, fruits, &c.? It is a more exact idea of the climate than pages of writing.

Mr. N. C. Meeker.—The club assures Mr. Rumford that just such accounts are always acceptable, and we invite farmers to give them, not only from the Pacific slope, but the Atlantic, and every part of the great central valley. As to his question about oranges, we suggest that he send to Louisiana for seeds and cions of the sweet, thick-skinned orange growing there. Oranges like a moist climate not very far from the sea. If he will address A. B. Bacon, of New Orleans, his wishes with regard to orange plants may be met.

Value of Coal Ashes.

Mr. William E. Clarke, Conneaut, Ashtabula county, Ohio.—I have used coal ashes, both anthracite and bituminous, for twenty years as an absorbent and deodorizer, and have found them so valuable that I have called them the farmers' and gardener's casket. In *The Plough*, edited by Solon Robinson, of August, 1852, page 261, we find an analysis of anthracite coal ashes, by Prof. Bunce, in which the soluble alumina is set down at three and a half to four and a quarter in white and red ash, and the insoluble matter at eighty-eight and a half and eighty-five and a half per cent (about) respectively; in other analysis that I have seen (see N. Y. State Ag. Reports, about the years 1845–46), this insoluble matter is set down at from thirty-eight to forty per cent. I have never seen an analysis of bituminous coal ashes, but believe them to contain a still larger amount of alumina. Now here is a larger amount of alumina than is contained in any soil, or even in the stiff Albany clay, so perfectly friable as to be more easily mixed and distributed than either soil or clay, and consequently far more valuable than either for the above purposes; and as coal is now so generally used, almost every family will have every day material enough to supply an "earth closet" ready at hand. I have used bituminous coal ashes in my hen house, sifting it directly under the roosts every morning, *instantly purifying the foul air*, keeping my hennery sweet and clean, and taking out in the spring a cart load of guano as good as the best. Coal ashes should be sifted and *kept perfectly dry* until used. I think that it is

by not observing this that so much difference of opinion exists in regard to their value.

FRUIT DRYING.

Mr. W. S. Philips introduced to the club a new and cheap way of drying fruit. Mr. B. R. Hawley, of Normal, Ill., has erected a dry-house on this principle, that can be used by any farmer. It exactly inverts the common methods of introducing the warm air at the bottom and taking it out at the top; he takes in warm, dry air at top, exhausting the damp, heavy air from the bottom. Thus using the law of gravity, the cold, damp air always at the bottom of the room is continually drawn off; and as warm, dry air is introduced, it spreads evenly over the whole apartment, and the room can be filled and emptied in from three to ten minutes at any temperature desired. By using the air in this manner, no steam is generated to discolor the article being dried. The house or room may be kept closed; no dust or fly-specks on fruit. Articles can be dried in very much less time. Hops were dried in two hours, without discoloring. It works on the same principle that the sun and a good wind combined does on a ummer day, only it will dry much faster. All danger of burning up either the building or the material dried is removed.

Adjourned.

December 22, 1868.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

RECLAIMING SWAMPS—DRAINING LAND.

Mr. C. J. Hillerand, Canton, Pa., writes: "Can you give me information as to draining mud-bottom lakes surrounded by marshes? Will it pay in those cases where it can be done without a heavy expense? If so, what time is best to drain off the water? What is the best method of cleaning the marshes of moss and teabush, or weed, as it is commonly called? What is the proper or best mode of cultivating land where the muck varies from three to ten feet in depth, and how long after it has been properly drained before it will be suitable for farming or gardening purposes?"

Mr. Wm. S. Carpenter.—The great difficulty in reclaiming a swampy piece of ground of any kind is getting a satisfactory outlet for the water. Judging of the locality from the description in Mr. Hillerand's

letter, the place to be drained is like a small lake, having upland around the margin. In managing my farm of eighty acres, in Westchester, I have had some experience in draining; but I had no lakes such as this correspondent describes. The first and chief question for Mr. Hillerand, or any other owner of swamp land, to settle is, whether he has the proper outlet. This can be made sure only by a good survey. The inflow of water from adjacent land must be cut off, and then sub-drains may be made through different parts of the swamp to good advantage.

It will not subserve the desired purpose to cut a ditch through the middle of the swamp. The true way is, if the expense of a large dam is reasonable, let him first carry a ditch all around the margin of the swamp. The water comes from the hills or higher ground near, and a marginal ditch will cut off all that water, and the work of draining the middle will be easy. When drained, such land will be much more productive than the natural upland. It will grow anything. Lime is necessary if the muck is very cold and sour. Herd's grass is a good crop to begin with, but corn will flourish wonderfully in four feet of black muck, when dry and warm; and roots, and clover, and cabbages, and timothy. He can take three crops of hay each season. As civilization advances, and capital drifts from cities back to the country, the means of reclaiming low marshy lands are more and more discussed.

Dr. Isaac P. Trimble.—If a satisfactory outlet cannot be cut for draining off all the water at the lowest point of the swamp, a large syphon may be employed to carry it over a rise of ground. Beginners should consult *Waring on Drainage* or *Todd's Young Farmers' Manual*, either of which will give full details for making all kinds of under-drains.

Mr. James A. Whitney.—If the water is drawn off in the autumn the frost will exert a very beneficial action on the soil, and I should say that this would be a better time than any other to carry draining operations into effect. The only way to kill out moss and other plants that grow in wet, sour soils, is to make the ground so dry and sweet that they cannot live in it. This is best secured by applying lime after thorough drainage.

Mr. Sereno Edwards Todd.—As all the foregoing inquiries have not been answered, I will state further, that all effort to exterminate moss, or any other plants, will be of no avail until the surplus water has been wholly removed. Before making any under-drains, the

true way is to ascertain the source of the water. By learning, before the drains are cut, where the water comes from, hundreds of dollars may be saved by forming drains where the water veins will be cut off, before the water is allowed to spread over the surface of the land. If, for example, the water comes from springs, let the drains be cut in the dry ground above the place where the wet ground appears. By this means all the water will be received into an under-drain, which can be made at any season of the year. A large drain, only, through the *middle* of a swamp, when the water comes from springs, will subserve no satisfactory purpose toward rendering the swamp sufficiently dry to plow.

Swampy ground, where muck may be ten feet deep, may be cultivated as soon as the surface is dry enough to be plowed. The most satisfactory way to manage such a piece of ground, after it has been rendered dry, is to plow it deep, and plant Indian corn for one or two seasons, or more, until the crude soil has been civilized and thoroughly subdued.

Eastern Tennessee.

Mr. Willis McClellan, Sulphur Springs, Tenn., writes in reply to a communication recently read before the Farmers' Club, upon the advantages, or rather disadvantages, of eastern Tennessee as a place of residence. He says that there are plenty of chances to gain a competence in that region, open to men who are willing to work for it. He, himself, has purchased and paid for a farm in a few years' time, and stocked it well besides. He says that the climate is healthful, and that the inhabitants are ready to welcome northern families who come to settle among them, and he regrets that carpet baggers, like the former correspondent, should spread false reports concerning a region offering so many real inducements to the immigrant.

Mr. R. G. Pardee.—During the past summer I traveled in the Sweetwater Valley, some seventy or eighty miles east of Nashville. Here the whole district had been swept by the war, and the farms were without fences; but better land I never saw in my life. I remember one farm, in particular, as having been sold for cash at sheriff's sale for eighty dollars an acre, and I was told that the same farm was worth in reality $150 an acre for agricultural purposes alone.

Nebraska.

Mr. Morris Benjamin, Boston.—"I would like to ask you through the medium of your club to give us some information about the State

of Nebraska as a place of settlement, its climate, soil, &c., or where we can obtain such knowledge, inasmuch as there are several in this vicinity who desire to locate in Nebraska and on the line of the Pacific railroad, if that region really offers fair inducements."

Mr. Tewksbury.—I am familiar with all that part of the country, but am not very favorably impressed with it. The Platte Valley is very beautiful, and possesses a good soil, but the river for all useful purposes amounts to nothing, except, perhaps, as a depository for sand-bars. There used to be good timber in the valley, but the most of it has been cut down by the railroad companies. I have been all through the west, and Nebraska is the last place in the whole of it where I should go to stay.

A Member.—How is it about the drouth in the fall?

Answer.—The entire country west of the Missouri river is subject to drouth, and Nebraska is no exception to the rule.

Mr. J. B. Lyman.—What kinds of timber trees will grow the best if planted?

Answer.—The locust, and generally those that have been found available on the prairies of the older western States.

Mr. J. B. Lyman.—Will the gentleman inform us what varieties of fruits will do well in the section we are talking about?

Mr. Tewksbury.—Nebraska cannot be recommended for fruit-growing. No peaches or anything of the kind seem to flourish there, and only a few varieties of apples; of these latter the wine-sap is the best.

Mr. J. B. Lyman.—What can be said of the wheat crop?

Mr. Tewksbury.—Very little wheat is grown there. Nebraska is emphatically a corn-growing region. The tillage is all done by machinery. Nothing by hand-labor. The corn is not perhaps as well tilled on the average as in some other portions of the country, but it yields as a general rule between thirty and forty bushels to the acre.

Mr. A. S. Fuller.—It is a truth not generally known that the old lands in the State of Delaware yield on an average nine bushels more of corn to the acre than the famous corn-growing fields of the west.

Dr. J. V. C. Smith.—Some portions of Nebraska are very desirable. It is a State that is full of resources that must eventually inure to the great benefit of the inhabitants. The railroad interests are developing with great rapidity, and this enhances the prices of farming lands. Some lands that were bought one year ago for five dollars an acre, are now worth ten dollars.

IMPROVED OATS.

Mr. Henry J. Rudisch, Home Place, near Fort Wayne, Ind., sends a half bushel of so-called Hungarian oats, which he has raised for a few years past, the seed having been received by him originally from the Agricultural Bureau at Washington. He says: "These oats do not produce such enormous crops as we read of; but yield, with fair farm cultivation, a reasonably good product, from seventy to seventy-five bushels to the acre, stand up finely, and resist the extremes of moist and dry weather to a wonderful degree. * * * They average in weight, through a series of years, about forty-five pounds to the bushel, which is their weight this year. The best common oats this year range from twenty-eight to thirty pounds to the bushel, as I am informed by a large dealer in oats. * * * This variety was tested with great satisfaction this season by a few farmers who got seed of me last spring. It will be well distributed this season, as I have disposed of my entire crop (amounting to several hundred bushels), except what I shall need for my own use.

I have such confidence in this variety that I send the package to be distributed among the members of the club, that they may test its merits next season by sowing it alongside of any other kind that they may desire to compare with it.

Mr. Wm. S. Carpenter.—Unless we are careful how this discussion on oats is conducted the farming community may be greatly deceived as to the merits of these new varieties. Now, if these oats that weigh forty-five pounds to the bushel in Indiana, were sown in central New York, the first crop would probably be heavier than oats commonly grown in that region, but the following year the grain would be lighter, and so on until it had degenerated down to the old average.

Mr. Wm. Lawton.—It is well understood that the introduction of seed from other localities will often of itself produce a better yield. Nature seems to require this change of seed and soil. It is quite common for farmers to go into another neighborhood for seed corn, even if it is no better than that which they had grown on their own land. The rule doubtless applies more or less to all kinds of grain.

Mr. A. S. Fuller (showing two samples of oats).—Here I show you one handful of the so-called Norway oats, and another of the oats that we have just been speaking about. You see that the oats from Indiana are a much heavier and better grain than the Norway oats.

Hops and Hop Poles.

A discussion on hops and hop poles was next introduced by a letter from Warren Ferris, of East Worcester, N. Y., who writes as follows in relation to what was said, at a previous meeting, touching the cultivation of hops:

To the Farmers' Club:

You have allowed discussion upon important branches of agriculture, and you do allow comments upon communications made to the club. Now, the comments on "hops and hop poles," made by James A. Whitney, is what I desire to answer. In the first place I would say, there is already too many hops raised. Those who have their yards in hollows and sheltered localities cannot expect a prime hop with any mode of training, and it surely does not pay to raise a poor hop. I would ask Mr. Whitney if air and sunshine are beneficial to the hop, and all other vegetation, or not? I think you will concede that they both are indispensable. Hops that grow in the shade are light and soft, and the lupulin or flour is imperfectly developed.

Again I would ask, does the twine plan of Collins shade the hop? We say it does, to the great injury of the hops. Collins' plan is this: Stakes eight or ten feet high are set and vines trained to the stakes, and, separated at the top of stakes, run horizontal in four directions on twine. Now, at the point of separating the vines at the top of the stakes, the laterals that bear hops appear. If you allow those arms or laterals to remain on the vine, a crow's-nest will be formed for the lice at the head of each stake, and if you cut off those arms you diminish the crop and bleed the vine at a critical period. The hops grown on this plan are all underneath the twine, and the leaves are directly over the hops, so that the hops are shaded nearly all the time.

Mr. Whitney affirms that there are very few hop-growers who would be willing to use only one pole to the hill. I have cultivated hops, more or less, for the past twenty years, and I have tried all methods of training the vines. But now I am using only one pole to each hill, with two vines to each pole. Last season my hop-yard yielded a clear profit of $200 per acre. The price obtained was sixty cents per pound, when, at the same time, right alongside, on my own farm and by my own tillage, hops with two poles to the hill were utterly spoiled. This year I have not sold my hop crop, but could have received twenty-five cents per pound, which sum would have netted me about $100 per acre. Hops that grow on one pole will weigh,

on an average, eighteen pounds to a box of ten bushels. Twined hops will weigh about fifteen pounds; and you will get a greater number of boxes of hops when the vines are trained on one pole than when they grow on two poles or on twine; and the hops from the one-pole system will be worth, on an average, two cents per pound more than those which grow on twine, or on two poles per hill.

The most satisfactory argument is the superiority of the hops themselves. So I herewith send to the club a sample of the "English clusters," and also a sample of the "New seedlings" raised by myself, which are fully one-third more prolific, and three weeks earlier than the "cluster," and a third larger in size. Please examine them. Mark their delicate flavor and rich golden color. Then let Mr. Whitney's twined hops or two-fold hops excel these, if he can.

WARREN FERRIS.

The samples, which were exceedingly fine, were then circulated for examination.

Mr. James A. Whitney.—I have never seen more beautiful hops than these, although there seems to be more brimstone on them than was necessary for hops of so fine a quality as these. These samples are both of a superior quality as far as regards freedom from rust or blight, but is not as strong a hop as is often found. The lupulin, or "hop dust" as farmers term it, is what gives the hop its value, and in this respect the sample is not above a medium grade. A hop that will ripen a fortnight earlier than the "cluster" will be an important acquisition. In many cases it would be ready for picking before the ravages of the aphis had injured the crop. With regard to the matter of stringing yards, if Mr. Ferris will turn to the report of what was said the other day, he will find that the Collins yard was mentioned only in comparison with other string yards, and what was stated then was substantially correct. The strings are merely substitutes for poles; and, like most substitutes, are not as good as the originals. Two poles to the hill, properly set, is the old method of poling hop yards, and it is the best; and some of the most practical hop-growers in Otsego county stick in a third pole sometimes, where the hill looks unusually thrifty. Four vines to the hill, is, however, about as much as a single plant or stalk will bear.

The Chairman.—Do I understand Mr. Whitney to say that sulphur is used as an adulterant in preparing hops for market?

Mr. J. A. Whitney.—No, not for adulteration, but to dry and bleach the hops. When the green hops are in the kiln, and in the sweating

stage, a little sulphur is burned beneath them. This has the effect of carrying off the moisture, and the hops are left of a good color. If two much is burned, the color is removed, and the hops are of a pale green.

Fraud in Putting Up Apples.

The chairman, at this stage of the meeting, distributed a quantity of large and beautiful apples, which, he said, was a portion of a lot purchased of a lady farmer in Connecticut, which you see are remarkably fine, and were just the same all the way to the bottom of four barrels. I take pleasure in handing them to the ladies present, as the product of a female horticulturist, or pomologist. I have here, also, some other apples which were put up and sold to me by a man. You see they are miserable, scraggy things, not worth a cent, and the man ought to be ashamed of himself for selling such trash. Two or three courses at each end of the barrel consisted of large and beautiful apples, but a large part of the middle of the barrel was filled with such small, knotty, wormy and worthless apples as scarcely a hungry man would eat. I would suggest that some means be devised by which the name of the producer may be made to appear on every barrel of apples that is brought to the city, so that every person who sends a barrel of good fruit may have the praise of it, while he or she who will practice such fraud as this may not escape proper punishment for the cheat.

Mrs. Dr. Hallock.—Mr. Chairman, I would like to present the apple given to me to any of the reporters here who will make mention of this contrast between the feminine and masculine method of doing business in the manner of putting up these two different specimens of apples.

Mr. S. E. Todd.—I will do it; not that I care for that apple, but because I believe female farmers, and females in any position, where they can have an equal chance with the opposite sex, are capable of discharging their duties with as much satisfaction to everybody as the opposite sex.

Mr. Wm. S. Carpenter.—I must say a word in defense of fruit-growers, who are assailed for such fraud as this. As a class, they are about as honest as the times will admit of, and very often are not responsible for the packing of poor fruit at all. Of late years speculators have been in the habit of buying up the produce of the orchards and packing it according to their own ideas of what is proper. It is not the fruit-grower, but the fruit-dealer, who is at the bottom of most

of the roguery in packing. The fruit-growers ought not to be held responsible for these frauds. They sell their apples on the trees to New York speculators, who pick and barrel them in their own peculiar way. The farmer is not generally tricky, but produce speculators—well, I do not feel myself called upon, Mr. Chairman, at this time, and before this body, to characterize a class of individuals. By their works ye shall know them. Do men gather figs of thistles?

WORMS AND INSECTS.

Mr. Ballas, a policeman at the Central park, gave an interesting sketch of his observations concerning the leaf and fruit-devouring insects found in the park. He described, at some length, the habits of the span-worm and other assailants of vegetation, and urged the necessity, if we would do away with pests of this character, of searching out and destroying their nests in the winter season, when they may be detected with comparative ease. For instance, the chrysalis of the span-worm is indicated by its cocoon, and the eggs of what has been termed the "plume worm" by a leaf which is always found stuck fast over the place where the eggs are deposited.

Mr. T. C. Peters.—I would ask if birds will eat these worms?

Mr. Ballas.—Very poor birds will do so. The cat-bird, however, is an exception.

Mr. A. S. Fuller.—Mr. Chairman, I know that the gentleman is right when he tells us to attack these vermin in the winter. One day's work now will do more good than a week's labor in the spring.

Dr. Isaac P. Trimble.—I would say a word with reference to the birds. The Baltimore oriole will attack the chrysalis in the cocoon. The weak point of the cocoon is at the lower end. The oriole digs an opening with his claw and then inserts his beak. The doctor, as collateral to the subject, then went on to explain the difference between a "miller" and a butterfly: A miller has a little knob at the end of each feeler, and a butterfly has none; furthermore, a butterfly always folds its wings upward close together, while a moth lays them down flat.

A Member.—What use may be made of large cocoons sometimes found on trees?

Dr. Isaac P. Trimble.—These cocoons are capable of yielding what may be termed a tow-silk; that is, the threads, instead of being long and uniform, are broken and tangled together. Something like this is very much used in oriental countries for making fabrics for clothing, which is very durable.

A Member.—Will Mr. Ballas tell us more about the insect-eating birds, the robin, for instance?

Mr. Ballas.—Robins feed on insects of different kinds pretty much all the spring. At that time, also, they eat whatever berries may have been left on the bushes from last year. After the first warm showers, however, angle-worms come to the surface of the ground, and then these make up a large portion of the food of robins.

Protection from Canker Worm.

Mr. W. V. Munroe, Lynn, Mass.—The farmers and gardeners in this country, and especially along the sea-coast, have suffered severely for a great number of years by the canker worm. Years of trial have done comparatively but little in exterminating this pest of our fruit. The present fall crop of the grub indicates a large accession to the army of the canker worm in the coming spring. Many, therefore, this fall, have fallen back, all inventions to the contrary, on the old system of using coal tar and printer's ink, as the only sure remedy for the evil. Some early spring and late fall birds are doing much good, although their number is very small. Some trials, I think, were made in New York and Boston, a year or two since, to introduce the English sparrow into this country, as the king of all birds for the destruction of these and other pests of our orchards. Has this enterprise all died out, or has it become impossible in this climate to foster and propagate this valuable and important accession to our feathered kind? Although we may be rather too far north, yet many feel a deep interest in this and any object or advice which may tend to exterminate these destructive pests of our orchards and fruit.

Mr. N. C. Meeker.—The movement to introduce the European sparrow has not died out, but is only in its infancy. These birds consume a great many kinds of millers and caterpillars. They may be seen any pleasant morning in summer chasing down white millers and yellow millers and consuming them. The millers which they consume are the same in size and color as those which breed the worms. In the city parks of New York great relief has been found from their advent. A general improvement in this respect will be seen when our birds, and especially blue jays, robins, and cat-birds are never molested or shot. The little single-barreled shot-guns in the hands of boys and idle youths have done as much as any change of climate or culture to bring on the evil of which our friend complains.

PREPARATION OF GROUND FOR FRUIT TREES.

A correspondent desired information touching the most feasible and expeditious mode of preparing land to be set with fruit trees where the soil is heavy. The inquiry was referred to Mr. Sereno Edwards Todd, who replied as follows:

"The easiest and most expeditious way of preparing a field for fruit trees, where the land is heavy, is to lay out the ground in lands, say thirty-two or more feet wide, or just as wide as the proposed distance between the rows of trees after they are transplanted. Now let the land be plowed in ridges, making calculations for the dead furrows to appear exactly where a row of trees will be planted. Let the lands be plowed three or four times, always turning the furrows toward the ridges, and continually away from the dead furrow. By this system of plowing, admitting that the plow runs six to eight inches deep, by going over a land four times, a broad and deep middle furrow may be worked down two feet deep with only the common plow and a single team. Then, after the last plowing has been finished, if a subsoil plow can be employed in the bottom of eight or ten of the last furrows, the entire ground round about the places where trees are to grow will be thoroughly broken up and pulverized to the depth of thirty to thirty-six inches. Let such fields be exposed to the frosts of winter, after which reverse the plowing, so as to level the surface, and put out the trees. This process will save a vast amount of fatiguing manual labor. On ground thus thoroughly made ready trees will grow much faster, and fruit much earlier than when set out in carelessly prepared soil, in the usual manner, with a spade, by simply digging only a small hole in hard ground, barely large enough to receive the roots of the tree. Fruit trees put out in land prepared as directed will grow in twenty years twenty or more feet high, and be loaded with fine fruit; while, if transplanted in the usual way, the same trees would not have grown more than ten to twelve feet high, and would not produce half the amount of fruit that they would have yielded had the trees been properly set out."

IMPROVED GATE.

Mr. D. McCurdy, Ottawa, Iowa, sends a description of a farm gate that he wants members of the club to try. It belongs to that class of gates which slide lengthwise through a swivel or pivoted post and then turns half way around to open the gateway.

Mr. Wm. S. Carpenter.—On my own farm I have thrown aside

the old-fashioned bars that caused me so much trouble when I was a boy, and have substituted gates in their places. I have, altogether, between sixty and seventy gates. I hinge them to their posts in the usual manner, but I take care to make their swinging or outer ends as light as possible, to counteract the tendency to sag. The best way to make a gate is to make it with the ordinary horizontal slats, but, in place of the heavy upright bar generally provided at the outer end, nail on two light upright strips of tough wood.

Clothes-Line and Halter Clench.

Mr. Williams, 82 Cedar street, New York, exhibited a novel device for holding clothes-lines when put up in their places. It consists in a small iron lever pivoted in a light frame, which is attached by screws to a post, the side of a building, or other like support. The end of the line is passed over the upper end of the lever and under or past the lower end in such manner that the strain on the upper part will cause the lower extremity to bite upon and hold fast the end of the line. The inventor proposes to apply the same principle in the construction of devises for fastening cattle-ropes to mangers, &c.

Adjourned.

December 29, 1868.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Scaly Bark on Trees.

Mr. D. A. Compton, Holly, Pa., writes as follows, concerning remedies for scales on the bark of young orchard trees:

"I have frequently understood that soft soap is a good remedy for the scales that some kinds of insects make on the bark of young fruit trees. I have tried this plan pretty thoroughly. I brushed the soft soap lightly over the bark, the young shoots, and also upon the leaves, but it failed; the insects kept on increasing. I should mention that I applied it in the spring of the year. Perhaps this was too early; or is the soft soap good for nothing for the purpose?"

Mr. William S. Carpenter.—Mr. Chairman: In this case the soft soap was probably not applied in the manner it should have been. It is not the soap, as such, that constitutes the remedy but the alkali contained in the soap. If Mr. Compton will make a saturated solution of potash and wash the diseased bark with it, he will find that the scales will be removed, but the trees will have to be watched and

the application repeated from time to time. This is especially true of trees growing where the grass is high. It is best to cultivate the soil of an orchard with some hoed crop, like potatoes, and the clean tillage will tend to prevent the attack of insects upon the trees. It has been found by experience, however, that buckwheat grown among trees does not increase the danger of disease from this source; but all other cereal grains, rye in particular, should invariably be excluded.

Mr. P. T. Quinn.—In the main, I agree with Mr. Carpenter. I have found that the use of potash is most efficient in the spring, say in April, when the sap begins to flow. It should be kept in mind, however, that we must be very cautious with the potash solution, for if it is allowed to touch the tender buds, it will kill them.

INSECT-KILLING SOAPS.

Mr. F. W. Woodward, New York city, writes concerning the soaps highly recommended by different venders for killing insects on plants. He says that a solution of such materials having one-twentieth of the strength prescribed by the directions given for their use, would kill roses, heliotropes, and similar plants dead as a door-nail.

Dr. J. E. Snodgrass.—The virtues of these soaps are generally due to the bresylic or carbolic acid which they contain. If made of the proper strength in solution they will kill insects. They are not intended for such tender plants as roses, and it is hardly fair to judge them by any such standard.

GREEN MANURING.

Mr. J. F. Pond, Olena, Ohio, asks whether, in the experience of the club, clover or sowed corn is the best crop to plow under?

Mr. W. S. Carpenter.—I don't think it makes much difference so long as there is the same amount plowed under.

Mr. James A. Whitney.—The roots of clover go much deeper than corn roots. They draw virtue from the subsoil up into the soil. Corn has very little power of this sort. In some soils the acid that comes of decomposing clover is useful in dissolving the mineral parts of the soil. For these reasons, I advise Mr. Pond to plow under clover.

Mr. R. H. Williams.—Something depends on the season of the year, and the crop that follows. Buckwheat rots quicker than either corn or clover, and of the two last mentioned, clover is quickest converted into plant food.

Deep Tillage.

Mr. C. E. Snow, Hanover, Jackson county, Mich.—I propose, with your permission, to review a few of Mr. Greeley's assertions in regard to deep plowing. 1st. The fact of the roots of some plants extending several feet below the surface I admit. I, myself, have traced the roots of the clover to the depth of six feet; but I deny that the inference is correct that they extend thus far in search of food. As well might he assert that trees extend upward in search of food, since a portion of their nourishment is derived by absorption from the atmosphere, whereas it is a fact that a low wide-spreading tree receives the most nutriment from the atmosphere; and this is also the case with roots of plants. Those which send out roots laterally and near the surface, receive the most support from the soil. A plant grows because it is its nature to grow until it reaches maturity, both upward aud downward. I have had the large thistle grow on land that was never plowed, to the heighth of six feet, mullen ten feet, and this because the surface was rich. Therefore I consider that system the best which will produce lateral roots instead of perpendicular. Does Mr. Greeley's sympathy extend to the bottom of the six feet root? and would he have us trench to that depth in order to have an easy passage for the roots through the soil? As large wheat as I ever saw grow grew on land that was not plowed at all. In fact the customary way of putting in wheat in the timbered land is to harrow it in without plowing, but merely burning off the brush, charring the earth perhaps an inch. I consider the object of plowing threefold. 1st. To obtain a seed-bed for the plant. 2d. To destroy the vegetation upon the surface. 3d. To enrich the soil. In regard to Mr. Greeley's concluding assertion, I would say that the success of a farmer does not depend so much upon the amount of work he does as that it should be done in the right direction. If a man attempts to reach a certain place by traveling in a direction opposite from it, the farther he travels and the harder he works the farther will he be from his destination. I commenced as a book farmer, and I have learned, by sad experience, the difference between theoretical and practical farming. We have had the report from Salem county. Will Mr. Greeley tell us how much he raises by working the soil twelve to fourteen inches deep?

Chair.—In the absence of Mr. Greeley, whose paper is thus referred to, and Mr. Trimble, who is known as the champion of shallow til-

lage, we will not go largely into this debate to-day. We hope to see both these gentlemen here next week.

Mr. Wm. S. Carpenter.—The correspondent appears to have read to very little purpose.

Another Member.—Or he has failed to read the right kind of books.

Mr. A. S. Fuller.—I wonder how he would raise beets and root crops on his soil one inch deep.

Mr. T. C. Peters.—These sidewalk farmers talk very glibly about the merits of deep tillage, and the demerits of shallow tillage. I have seen beets grow on land tilled only three inches in depth.

Mr. A. S. Fuller.—I would like to know what the gentleman means by sidewalk farmers. Most of the speakers here have held the plow and turned the furrow on their own land, and may be presumed to know something about plowing. I, myself, have tilled the soil on four farms in as many different States, and once cultivated prairie land for nine successive years. The true question at issue is not whether crops will grow on new land that is rich and deep and comparatively loose by nature, but whether we can increase the yield on old fields that have been cropped for years. As to Mr. Peters' remarks on beets growing in three inches, what he says may hold good of mangel-wurzel that grow two-thirds out of the ground, but not of a sugar beet, or common blood beets that grow ten or fifteen inches below the surface and one or two above it.

Mr. J. B. Lyman.—The whole matter amounts to simply this: When land is new and strong, plants may thrive upon the plant food that lies near the surface, but this is soon exhausted. As has been remarked here this afternoon, wheat may sometimes be grown for a number of years in succession on some soils with light tillage, but these exceptions only prove the rule; and even in such cases there is nothing to show that the crops would not be heavier if the land were pulverized to a greater depth. A soil must eventually be worn out by surface cropping, and the philosophy of deep plowing is only to allow the roots to go down after nutriment that they could not reach without it.

MANAGEMENT OF EGG PLANTS.

A correspondent at Bailey's Mills, Florida, says: Will some of the members of the Farmers' Club tell me of a good plan for insuring the germination of egg plant seeds? It has always been

extremely difficult in this neighborhood to obtain even plants enough for a family supply.

Mr. S. Edwards Todd.—In reply to this inquiry, I would state that, on account of the extreme tenderness of the young egg plants, it is sometimes difficult to secure even a limited supply of prime plants. If the seed be planted very early in the growing season, the young plants are liable to be chilled, so that they never recover from the injury. The young plants are quite as delicate and tender as spears of Indian corn; and unless the seed and growing plants are properly managed at the outset, every effort to raise a large crop will fail. If the seed has been saved with proper care, and is really good, one ounce will produce from three to four thousand plants. Like all other tender plants, the egg plant requires the advantages of steady and permanent heat, from the time of planting the seed until the period of cold and chilling weather has passed. The chief difficulty in growing egg plants is planting the seed too early in the growing season. Seeds of the egg plant are often sown in March; but in many instances, if the tender plants can be protected and kept alive until May or June, when they can be put out into the open ground, plants that have sprung from seed sown in April will be quite as forward in June, and will yield more fruit than those which were planted in March. Very much will depend on the variety. The "New York Improved" egg plant will give better satisfaction, I believe, among the market gardeners than any other variety. Twenty days before the weather will be sufficiently warm to put the plants out in open ground, let a hot-bed be prepared for the seed. Let much care be exercised in the management of the hot-bed during cold nights, that the very young plants may not become chilled. When only a few plants are desired the better way is to plant the seed in pots, which should be kept in a warm room until it is time to transplant them. Egg plants require a rich soil, warm weather, and clean cultivation.

Mr. P. T. Quinn.—Mr. Todd differs somewhat in opinion from the market gardeners. The first requisite in raising egg plants is to get good seed at the outset, and after this comes the proper management of the hot-bed in starting the plants. In this latitude we never put them into the hot-bed later than the tenth of March. Great caution must be used in regulating the temperature of the beds, and the plants must be transplanted about three times before being put out.

The object is to obtain a stumpy, hardy plant which we can put out by the middle of May.

Saving Barn-yard Manure.

Mr. S. Edwards Todd.—As there is no surer way of obtaining good crops than by using liberal supplies of manure, and no pleasure or profit in farming, unless large yields are obtained, we can think of no better investment for farmers than to stop sources of waste in the manure yard. Of course it will require some labor; but not near so much as the value that will accrue.

The way, of course, to save manure from washing is to put the accumulations where they will not be leached. Generally, it will be practicable to wheel it from the stables to some central place, either under shelter or where the water from the roofs will not touch it, and there piled in large heaps, or be spread out.

To hold the portion which is lost by evaporation, it is necessary to have some absorbent which will take this up. This is furnished in large quantities on almost every farm, in the shape of muck, turf, rotten wood, leaves from the forest, or finely cut straw. These substances, used freely in the stable, will not only absorb all the liquid and gaseous portions of the manure, but keep the air sweet and healthful. Farmers will do well to make their calculations beforehand for procuring proper quantities of these materials to be used in the winter for this purpose. Not only will they hold that portion likely to be lost, but the absorbents will themselves be converted into good manure in the course of a few months.

Farmers often remark that they have little or no manure with which to enrich their fields. They tell the truth; but they do not always tell the *reason why* they have so little. One would almost think, to hear them talk, that all the hay and grain they fed was assimilated, rather than passed from the animals for manure. Any observing man, however, will have noticed that there are two sources of great waste of manure on almost every farm.

The first is the loss occasioned from its being washed away by heavy rains, and carried beyond the reach of the farmer into brooks, rivers, the lake, and finally the ocean. Very few are aware of the amount lost in this way. Many barns are so located that the manure heaps are washed by the water from the eaves of the building to a creek, but a few rods away, and in the spring half the value of the heap is gone. Almost all that is dropped about the yard or farm in

winter suffers more or less from the same cause. We do not believe it would be far out of the way to say that half of the manure is carried off in this manner.

The second source of waste is by evaporation of the volatile portions. How much goes into the air in this way, to poison it for breathing purposes, and to be lost to the farmer, would be difficult to tell. But any one who will observe how heavily the air is loaded with this volatile portion, in stables and about barn-yards, cannot fail to be convinced that it is no trifling quantity. By exercising proper care in saving barn-yard manure, many farmers can accumulate more profit than in any other way.

Geometrical Harrow.

Mr. Kelsey exhibited a model of a new harrow, having the geometrical form of two equilateral triangles, one placed behind the other. The harrow had a scraper hitched on behind, and the scraper had a handle sticking up at its rear end. Mr. Kelsey stated that the machine would pulverize the ground twice in passing over it once. When you didn't want to drag in grain any more, you could take off the scraper and work on the road or dig cellar with it.

Wm. S. Carpenter.—I consider the common harrow a very defective implement for the pulverization of the soil. I have tested a rotary harrow, which operates in a very superior manner, and I think that the time is coming when the rotary system will be very extensively adopted in instruments of tillage.

Universal Wheel Plow.

Mr. Cowen, of New Orleans, La., exhibited a small model of a wheeled plow, which he stated to be now in process of construction in Brooklyn, N. Y. The model showed a frame furnished with plowing shares that could be raised or lowered to cultivate any depth desired. The apparatus is also furnished with a seat for the driver, and over the seat is a top which is intended to be placed flat when used as a shade, and be turned up in a vertical position when "running before the wind," but for what purpose did not clearly appear. The inventor wished for an expression of opinion as to the merits of the machine, but was counseled to await the completion of the trial apparatus, when a committee may be appointed to examine and report upon it.

NEW PLOW CLEVIS.

Mr. T. P. Warren, Norfolk, Va., exhibited an improved plow clevis, so constructed that it may be placed either upon the top or side of the plow beam, and the special merit of which lies in this, that by its use the plow may be more easily guided to cultivate closer to rows of plants than where the common clevis is employed. The device is best fitted for one-horse plows.

Messrs. P. T. Quinn and W. S. Carpenter both expressed their interest in this improvement, and a belief that it will be of great value in certain operations.

PLANT PROTECTOR.

Wilkes & Watson, Sharon, Mass., send specimens of a plant protector, which consists in a conical net, furnished at the bottom with a hoop, which is pressed into the ground around the plant, while the net is sustained over the latter by a supporting stick, which is stuck into the center of the hill. It is claimed that the device will prevent the ravages of the wire worm. One of the members expressed the opinion that, although it might be useful in protecting strawberry plants, for most vegetables it would prove little or no better than the hoop in common use.

LONDON BUSH SQUASH.

Dr. Hexamer, Newcastle, N. Y.—I have brought to the club these specimens of squash. I know of no variety superior to it. The flavor is fine, they are hard, they keep at least half the winter, and when cooked the flesh is white like well mashed potato.

IMPROVED SWEET CORN.

Mr. D. B. Bruen, Newark, N. J., exhibited and afterwards distributed several very fine ears of a variety of sweet corn originated by himself many years ago, and which has been very well thought of both by producers and consumers.

Adjourned.

January 5, 1869.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

TREE PLANTING.

Mr. Geo. W. Shaw, of Garden Grove, Iowa, writes, in relation to the culture of forest trees, that in October, 1864, he planted a row of

walnut trees, and that now some of the trees are twenty feet high and six inches in diameter near the ground. He regrets that he did not plant out twenty acres in the same way, because it would have made the land worth $100 an acre now, instead of ten dollars. Farmers who have bare fields, where slight harvests are reaped, will do well to ponder this fact, as it shows how soon a tall belt of trees may be grown on the windward side of a farm or garden, to shield buildings or fields from the cold and piercing winds of our northern winters.

OSAGE ORANGE HEDGES.

Mr. W. R. Davis, Galion, Ohio, writes: "Let the plants remain as they grow in the nursery until spring, but protect them by drawing dirt enough around their stems to cover three or four of the lowermost buds. In the spring, when the ground is dry, raise the plants, and head them off to two buds; reset them in hedge-rows without allowing the small fibrous roots to become for a moment dry. By following this plan I lost only a single plant in a 1,000, while my neighbors, who wintered their plants in the cellar, lost about 300 to the thousand.

NORWAY SPRUCE.

Mr. J. Glidden, Clarendon, N. Y., would like to ascertain where seeds of the Norway spruce can be obtained, and also the best mode of culture for the young trees.

Mr. William S. Carpenter.—The seed can be purchased at any of the seed-stores in this city, but I would advise Mr. Glidden not to experiment with the seed, but to purchase the plants or young trees from the nurserymen. It is almost impossible to raise the Norway spruce from the seed without great experience and skill. The young plants may be protected by glass, or in default of this, by sowing barley or oats among them, which shields them from the direct rays of the sun.

ADULTERATION OF HORSE-FEED.

Mr. J. V. Ridge, Philadelphia, Penn.—I take much interest in all that is said or done at the Farmer's Club, as I find it reported in the papers, for I used to be a farmer myself. There is one thing that I wish it would take hold of and ventilate, so that the farmers may know how they are being swindled by the dealers in cities. This is, the adulteration of all kinds of food, both for men and stock, that are sold as pure articles to the country dealers, and they retail them to

the farmers. I saw a letter a few days ago from Mr. Henry Bergh, that friend of the brute creation, where he says that the ground feed sold in that city is as much as half made up by plaster of Paris. Gypsum is very good on clover land and does very well to make images for little Italian boys to sell, but it has no business in a horse's stomach. Can't the club do something to stop such swindling? I hope so.

The Chairman.—I have frequently taken occasion to express my belief that *The World*, in exposing the outrageous system of adulteration to which articles of food and drink are subjected, has accomplished more good for the people at large than any legislation in the matter could have done, because its words have been heeded where the voice of the pulpit or the tracts of the temperance societies would have went for nothing.

Mr. Thomas Cavanagh.—I have no sympathy with swindlers. But Mr. Davis ought to have gone a little further, and told something to balance on the other side; how country people swindle citizens and all classes of consumers by lashing large billets of wood to the bales of hay they sell; by the tag-locks they put inside of fleeces of wool; by the sand and dirt they mingle with their grain, and in many other ways. The swindlers do not all reside in the city. I think that country people can and *do* swindle, by adulterating their commodities, about as much as those people who live in cities.

Dr. Hallock spoke earnestly of the petty swindling and cheating in almost everything that is weighed and measured, which is not confined to any locality. Legislation, he said, is utterly inoperative meeting this crying evil. The only remedy is by following the evil up until we can produce such a moral status, such a moral sense of the odiousness of the crime of selling adulterated articles for genuine ones, and employing false balances and unjust measures, that people will be constrained to deal fairly, on account of their moral sense of the heinousness of the offense of swindling. I have great confidence in people to believe that when they see their abominable practices held up to the gaze of the world, they will abandon such schemes, and deal fairly and justly. I hope the club will take up this subject of adulteration and make itself a means of rousing public opinion with regard to the enormity of the frauds that are carried on, and do its share in creating a higher standard of business morality among manufacturers and dealers. Who that has any proper sense of moral rectitude, can hear or read our discussions on this subject, and then

go back to his old abominable practices of swindling? I have more hope of reaching this evil through the discussions and published reports of the proceedings of this club, than in the efficacy of any other scheme.

Mrs. Dr. Hallock.—The doctor is more sanguine than I can be in regard to the moral sense of petty swindlers. So long as human nature remains what it is, I am afraid it will be impossible to restrain fraudulent dealers by mere appeals to their moral sense. We cannot know the injury done in the community by food mixed with hurtful materials. The deleterious influence of such worthless material as is taken into the human stomach, with the adulterated food and drink, cannot be computed.

Some physiological writers have stated that both men and animals usually live about five times longer than the period required for their perfect growth. Man reaches that point of perfect maturity in about twenty years. Therefore, according to that computation, people ought to live until they arrive at the ripe age of one hundred years. But how can they be expected to live to that age, and who among us expects to live to one hundred years when his or her health is undermined and impaired from childhood to old age by the very food that ought to promote vigor and long life.

Mr. D. B. Bruen said that he once had occasion to examine the loaves made in the bakeries of our neighboring village of Newark; they were all short weight. Bread should be sold by weight, instead of in loaves of any size the bakers choose to make them.

A member.—Selling by weight will not remedy the worst of the evil. The dealers will adulterate the flour, just as they do the provender for horses, with plaster of Paris and other similar substances.

Dr. J. E. Snodgrass.—I have been astonished to see to what great extent the adulteration of bread is often carried by the addition of poisonous material. The great evil of all this is, that this adulteration of what we eat and drink, and feed to our horses, not only swindles us out of our money, but makes us take poisonous materials into our stomachs. Think of gypsum and alum as articles of diet! Some years ago I was called upon to investigate a matter of this kind, and came across evidence concerning a large quantity of marble dust that had went in the direction of certain suspected flour barrels. As to the trick of short weights, even the street retailers have learned it. You will often hear them crying figs for ten cents a pound, when good figs are sold at the fruit stores for twice as much.

In these cases the article is old and sophisticated with other substances, and if you look sharp you will often find a lot of figs stuffed under the pan of the scales. I have seen as much as half a pound placed in this manner to load the pan. Of course, their "pounds" are not more than eight or twelve ounces, more or less.

The Chairman.—The most wondrous thing of all is that we can take so much hurtful and poisonous material into our stomachs, and still live and enjoy fair health.

Mr. A. S. Fuller.—Some time ago I was laughed at because I remarked at one of these meetings that the artificial fertilizers sold in the market were fit for nothing but to be thrown into the river. I said this, not because I believe it impossible that a good commercial manure can be made, but for the reason that all the different kinds puffed before the farming community are adulterated to such an extent as to be practically worthless. And so it is with ground feed. I gave up its use long ago, for I found I could not get it pure. I could not repose confidence in the miller. Where can we purchase feed for teams and stock, and feel assured that we get pure ground grain and nothing else?

ADDRESS OF MR. BUSH.

Hon. Mr. Bush, of Pennsylvania, took the floor, and gave an interesting address, in which he spoke of the salutary influence of the Farmers' Club on the farmers in his State. He stated that they repose so much confidence in the judgment of the men who take part in the proceedings of this club that if a new potato, or a new variety of apples, or pears, or any new farm implement is indorsed by this club, they are not afraid of it. On the contrary, let them see a new potato, or apple, or machine spoken against by this club, and I defy an agent to make a sale among them. This club has become a kind of *reliable authority* with them to direct them in all the operations of the farm.

The speaker desired the club to select and recommend an apple for general cultivation, that will be among apples what the Concord grape is among the grapes of our country. He said the country desires an apple that will resist the attacks of insects, and the injuries arising from atmospheric influences. He also complimented the liberal spirit that prevailed here in regard to the rights of the female sex. Let them have their rights, said the speaker, with proper earnestness. [Applause.] I see lady tillers of the soil among you.

It is right that they should be allowed to relate their experience in horticultural and agricultural matters.

The Chairman.—We always respect their rights, as they are connected with the nursery business. [Loud laughter and applause.]

Varieties of Potatoes.

Dr. F. M. Hexamer, of Newcastle, N. Y., places two potatoes of a new variety on the table, that people might look at specimens which were held at fifty dollars a piece. Mr. Albert Bresee, of Hortonville, Vt., the originator of the Early Rose potato, was introduced to the audience and exhibited specimens of a new variety, termed Bresee's No. 4. This potato originated from the Garnet Chili, the same seed-ball as the Early Rose, and is claimed to be ready for the table about a week sooner than the Early Rose. It has not yet been introduced to any extent, the single tubers being valued at fifty dollars each. Mr. Bresee exhibited also another seedling which he proposes to call the "Prince of the Early's," like the No. 4 above mentioned, which is believed to mature earlier than the varieties commonly cultivated.

The merits of the Early Rose were highly extolled by several farmers who had raised that variety the past season.

Dr. Isaac P. Trimble.—I think we are running the potato question into the ground. It has been acknowledged on this floor to-day that the quality of the Early Rose is not superior to the Peachblow. There is a great error in all this talk about the relative merits of different kinds of potatoes, for the reason that the Peachblow is taken as the standard. The Mercer is a better potato than the Peachblow.

Mr. Aaron Stone, of Long Island.—In my vicinity we adhere to the Peachblow, as the most profitable and every way the best potato.

At this point Messrs. Carpenter, Quinn and Crane united in the statement that no farmer could afford to grow the Mercer, even if it would bring five and six dollars a bushel, inasmuch as it is very liable to rot, and matures so late as to be in danger from frosts.

Mr. J. L. Conover gave some of his experience in the cultivation of the Early Rose the past season. He stated that he planted 154 bushels of the Early Rose potato, and harvested from this planting fully 1,000 barrels. Some have tried to depreciate the reputation of this variety by saying that it is liable to rot, and may not yield over forty bushels to the acre. My own experience disproves both of these assertions. I used about 250 pounds of Peruvian guano to the acre, on sod ground, and the yield surpassed any other that I have

ever had, except from the Harrison, which once yielded me 196 barrels from one barrel of the seed potatoes.

Mr. J. C. Thompson, of Staten Island.—What is your opinion of the quality of the Early Rose?

Mr. Conover.—The quality is very good, fully equal to that of the Peachblow.

Mr. Thompson (who, by the way, is an excellent farmer on Staten Island, and who raises superior crops of potatoes).—I can fully indorse all that has been said about the Early Rose. I have tried the Early Rose very thoroughly, and think that it excels all others that I have seen, both in quality and productiveness.

Mr. Wm. S. Carpenter.—I have raised this potato on my own land, with very profitable results. I planted seven pecks, and raised 150 bushels. I was very careful to separate the eyes, and plant only one in a place. I found that on the average each eye produced five pounds and nine ounces of the tubers.

Mr. John Crane.—With me one peck of seed gave twenty-six bushels of potatoes. I noticed, however, some instances of the rot. About a peck was lost from this cause.

Other members present who had cultivated the Early Rose, acknowledged that the variety is not entirely exempt from the rot, as has been claimed.

NEW VARIETIES OF APPLES.

Dr. J. C. House, of Lowville, N. Y., spoke of two new varieties of excellent apples, of superior quality, and worthy of more extended notice than they have yet received. Having this favorable opinion, he professed his willingness to furnish cions gratuitously to those who may wish to test the new varieties by grafting. He said these two new apples originated in northern New York, and are known respectively as the Golden Pippin and the Perry Redstreak.

DEEP VERSUS SHALLOW TILLAGE.

Dr. Isaac P. Trimble.—As the hour for our special subject has arrived, and as Mr. Greeley is not present, I move to postpone the subject until another week.

The Chairman.—This subject has been postponed from week to week, for the three past weeks. I shall therefore rule that it be now taken up. Dr. Trimble, who appears as the champion of the advocacy of shallow plowing, will open the discussion.

Dr. Isaac P. Trimble.—I have noticed in a report of the proceed-

ings of this club of last week that I am called the champion of shallow plowing. This is not strictly correct. As a practical farmer I have tried both deep and shallow tillage, and I have seen many others try both.

Some years ago, when so much was written about subsoiling and trenching, I supposed that we were on the very borders of a great advance of agriculture; that our lands were soon to be made doubly productive by deeper tillage. But my own experience, careful observations of the experiments of others, and especially the testimony of the farms and farmers of Salem county, New Jersey, have caused me greatly to change that opinion. I have often seen naturally better lands than the uplands of Salem county. My own native hills of the Brandywine are decidedly better. The Miami lands of Ohio, the blue grass lands of Kentucky, and in Pennsylvania much of Lancaster, Berks and Lehigh counties are better; much of the Cumberland valley, &c. The same may be said of a great deal of New York and all the western States. Fifty years ago these lands of Salem county had become greatly impoverished or worn out by the old style of farming; while, in many parts of our country, lands subjected to similar hard usage remained uninjured.

Two years ago a committee from this club reported that they had seen, in a ride of thirty or thirty-five miles in Salem county, about seventy corn fields, and they and the gentlemen they traveled with estimated the average crop of shelled corn per acre of these seventy fields at between seventy and eighty bushels. That was in August. The clover at this time was so rank that the stubble where wheat had been gathered a few weeks before could not be seen. Other indications of first-class agriculture were constantly manifest.

I have traveled, more or less, in nearly all of the United States, and I have a passion for watching the agriculture everywhere. I have seen good farms and good farmers often; but that community of farmers in the several townships bordering the old town of Salem, in Salem county, New Jersey, are the very best I have ever seen. Their rule of plowing is five inches or under; some so shallow as three inches; the average probably four inches. This shallow tillage with them is comparatively recent. The laboring men of some of these farmers, in their absence, have disobeyed orders, and have been what Mr. Fuller calls very lazy. Fields were only half plowed. In some of these cases of very shallow plowing, where the owners expected nothing, they have had the best crops of the neighborhood.

The best crop of a neighborhood becomes the common talk, and the reason why is thoroughly investigated. These accidental successes have led to the general adoption of comparatively shallow tillage by the intelligent, painstaking and successful farmers of that county.

Deep tillage is both laborious and expensive, and if never useful and often injurious, let us find it out. When the coming steam plow is actually here, those who choose may run the thing into the ground as deep as they choose; but, in the meantime, let us be merciful to the animals that do the plowing, unless we know that deep plowing pays.

Much stress is laid on the circumstance that the roots of various plants are often found at great depths in the ground. This is not denied. In the very careful examination of the roots and rootlets of corn in the field in Salem county, where the ground had only been plowed three inches deep, ninety-nine hundredths of them were found within that distance of the surface. The hills of that corn were four and one-half feet apart, each way, and from two to three stalks in a hill. The corn was then just shooting in tassel. This whole surface of three inches, and especially the lower or sod portion of it, was a mass of corn roots. They were reveling in the food contained in that soil, especially the crumbling sods. In digging down deeper and examining carefully, we found other roots, here and there one, but bearing no more proportion to those near the surface than the *tap-roots* of nursery trees do to the laterals that go off in every direction and multiply almost *ad infinitum.*

Since the examination, I have repeatedly noticed the same thing in my own garden. Hoe your corn two or three inches deep at the time the ears are forming, and you will cut off these delicate roots by thousands in each square foot. It is then in fact a mass of fibers. You hardly know which predominates, the rootlets or the earth itself. Now, why these few stragglers leave the main body and ramble down to such depths, I do not know. Mr. Greeley says, "they seek food and find it;" though further on he speaks of the "cold, lifeless" subsoil. Those roots go down for a purpose, undoubtedly; but that they get food is not proved. Such roots can be found in a subsoil in which, if the surface soil were taken off, nothing would grow.

Mr. Andrew S. Fuller tells us that when nursery trees are taken up to be transplanted, the *tap-roots* should be cut off. Why this discrimination between young trees and other plants? If trees are

injured by the wayward rambles of *tap-roots*, why "let down the bars" for the roots of other plants?

Much is said of *loosening or mellowing* the ground, and some say the deeper the better. Hence subsoil and trenching. Are these necessary?

I was told by farmers in Salem county that their crops, and especially corn, did best when planted on ground plowed in the fall or winter, and only harrowed in the spring. The seeds germinate as well and grow to three or four blades in thoroughly loose ground as in that more compact, but after this they seem to stop, and time is lost, unless a seasonable rain comes to pack the earth just where the young roots want to go. In loose ground there are spaces of air as in stone heaps, the rootlets with the hungry spongioles at the end of them have a perpetual hop, skip and jump, from one clod through space to another clod. The native element of roots is earth; they want it everywhere, just as we want air, as fish want water. Much is said about "aerating" the soil. Has it been proved necessary? Theoretically, I would suppose earthing the air for the tops of plants would be as necessary as airing the earth for the roots.

Even if loosening the soil and the subsoil are useful, have we any proof that the effect of deep plowing and subsoiling are at all permanent. Every fence maker knows that the earth taken from a post hole will not refill it if well packed. Hidebound meadows in stiff clay that are so often plowed to loosen them, if well top dressed with barn-yard manure, in September, would in a month return thanks for such a manifestation of good sense, and the next summer, instead of half a ton, would give you two tons of hay to the acre.

I often watch the habits of insects that pass part of their lives in the ground. The female of the seventeen-year locust deposits her eggs in the twigs of trees; but the young locusts, almost as soon as hatched, throw themselves to the ground and at once pass into the earth. I have often been amazed that anything so young and so feeble could penetrate the earth so rapidly; but they seem to have no digging to do. Everywhere there seem cracks and fissures, just wide enough for their free passage. It seems as easy for them to pass through earth as a fish through water. Why is it not just so with the rootlets of plants?

In the paper read here some weeks ago by Horace Greeley on deep plowing, he says in his eighth proposition: "In a wet season, deep plowing does at the worst no harm. In a dry season it doubles the

crop." Is this true? If so, agriculture becomes at once a fixed science, and the struggle for life that Darwin speaks of is ended; there will be no more struggling except to push in the plow, and steam will probably soon do that.

I have lately been assured by letters from Salem county that the field plowed only three inches deep, so often spoken of, has yielded sixty bushels of shelled corn to the acre, except where shaded by adjacent woods. That district of country was parched by a drouth of six weeks when we saw it, and it continued six longer. During all these twelve weeks they had a few slight showers, but not enough at any time to reach the growing potatoes in the hills. Now, according to Mr. Greeley's theory, had that field been plowed six inches deep, it would have yielded 120 bushels of shelled corn to the acre, for certainly it was dry enough to come up to his requirement in that respect.

Here is some corn sent me by Joshua Thompson of Elsinborough township, near the city of Salem. He has forty acres of such corn, and his Quaker neighbors write me that every acre will produce 100 bushels of shelled corn. He plows as his neighbors do, five inches or under. The drouth extended to this farm also, but was not so severe as a few miles away. Would he have had 200 bushels by plowing ten or twelve inches deep? On the contrary, probably not fifty.

In consideration of this crop being four or five times more than the average crop of corn of the United States, it may be interesting to know Mr. Thompson's management. He has eighty acres of upland; one-half is in with corn, and one-half with wheat every year. The rotation is corn, wheat, and clover, or clover, corn, and wheat; but oh, how he does put on the *barn-yard manure.* Mr. T. is one of the Salem county farmers that owns a portion of the 15,000 acres of banked meadow. On this he pastures his stock in summer, from which he gets those huge stacks of hay that are thrown out so profusely to his stock in winter.

These banked meadows are the deltas of the Lower Delaware; the accumulated deposits since the creation, formerly covered by water at high tide, but all mud at low water. Like the deltas of the Lower Mississippi, or the lands redeemed from the sea in the Netherlands, they are inexhaustibly fertile. They are not like the banks in which Mr. Greeley keeps his accounts; you may draw and draw upon them without replenishing, probably as long as there shall be "seed-time and harvest."

While I have little faith in subsoiling or trenching, I do believe firmly in draining. How many thousands of the farmers of our country have low lands and swamps worse than useless, that could, by proper drainage, be made the most productive portions of their farms.

Mr. Greeley in his 9th proposition says:

"9. Unless a small army is more effective than a large one, an empty pocket-book better than a full one, a lean crop preferable to a large one, then a deep soil must be more productive than a shallow one."

All which no one will doubt. That *deep soil* is what we all want, but how are we to get it?

The plow is a very useful implement on a farm, but it is not a fertilizer. It will not make humus or any other of the ingredients of plants.

His 4th proposition says:

"4. What we advocate is not the burying of the mold or natural surface soil under several inches of cold, lifeless clay, sand, or gravel. If the subsoil is not to be enriched, it may better remain the subsoil; but that does not prove that it ought not to be lifted, stirred, aerated, pulverized. The right thing to do is to enrich as well as mellow and aerate the entire soil to a depth of fully eighteen inches; though twelve may answer for a beginning."

The meaning of these different passages is obscure. The farmer who has an "*entire soil*" of the depth of eighteen inches, or even twelve inches, may plow either deep or shallow, and it will make very little difference; but, excepting alluvial or drift, we never see such soils, and the inference is that we should plow to the depth of the vegetable mold with the ordinary plow, and loosen below with the subsoiler.

Some years ago a considerable number of the Salem county farmers used the subsoil plow. They all met together after having tested it, and by common consent resolved that subsoiling did them no good, and not one of them now uses the subsoil plow. David Pettit subsoiled thirty acres, excepting a narrow strip; on that strip the crop was the best. Other testimony, both there and elsewhere could be given to the same effect.

Farmers, as a general rule, are extremely cautious in trying new things, especially if expensive. Their gains are moderate, and the result of toil; hence they risk little in experiments. But how closely they do watch the experiments of others.

I have seen subsoil plowing, and trenching for many years, and in many places, but I never have seen the farmer, nor I never have seen

the man who has seen the farmer, who have so clearly proved their value as to cause the general adoption of either of them by their neighbors. So far, there is certainly a want of faith in those who have been looking on.

As to trenching, I have tried it twice in my own garden. Having more stable manure than I cared to use on the surface, I buried it freely by trenching to the depth of eighteen inches, or twice the depth of ordinary spading. Those parts of the garden have never been better in any respect than the parts untrenched. In this experiment manure enough was wasted to have made as much poor ground rich.

Mr. Greeley describes very properly in his five first propositions what kinds of land should never be plowed. But when he says, "If plants cannot find more anchorage, moisture, and food, more certainly, and more abundantly, in twelve to eighteen inches of soil, than in six, then reason is a fool, and mathematics a conjectural science," all of which appears to me to be an assumption to avoid the question at issue. As to anchorage, many of our mightiest forest trees rest only on a broad expanse of roots lying just under the surface. Were it possible to lift them out bodily without breaking the roots, and set them down somewhere else, they would still stand almost as firmly as before. Those who have traveled in a beech woods will know what is meant by a pavement of roots. I have traced the roots of the tulip tree for one hundred feet, and all the way partly above ground.

As to the moisture sought for by the roots that run down many feet, the moisture of the earth passes off by evaporation. If these roots will remain near the surface, the moisture will come to them.

As to the food sought after at those depths, it is possible they may find something they want.

In clearing off the forests, in many of the new settlements, stump-pullers are used. As far as I have observed, the roots of these stumps run the deepest in the poorest land; and the inference is that plant-food could not be found near the surface.

I can imagine that the upper stratum of drift land may be poor and the subsoil rich, and that they might be transposed to advantage by deep plowing.

I can also imagine that alluvials might be plowed deep to advantage, but the owners of such lands tell us they find it best to plow only two and a half or three inches, just deep enough to cover the sod. I have passed many weeks on a plantation made by drainage in

the Dismal Swamp of North Carolina. Much of it had been cropped annually with wheat or corn for more than fifty years. The ordinary teams for plowing were a pair of mules.

If the crops fail lime is used; but I never heard of deep plowing, although there seems no limit to the depth of vegetable mold.

The great art of agriculture is advancing rapidly. The genius of the inventor and the skill of the mechanic are making us implements and machinery to economize labor.

The chemists, by analysis, are showing us what plants and fertilizers are made of, and how the one should be fed to the other.

But to the practical farmer, who has had long experience, and who reads and thinks, we are most indebted for the solid advancement of the art.

When Joshua Thompson gathers 100 bushels of shelled corn from an acre of ground, by comparatively shallow plowing, it signifies something.

When George Abbott says he plows six inches deep to make room for his superabundance of barn-yard manure, we infer that if he had less he would plow shallower.

When David Pettit tells us he has tried subsoiling and abandoned it, it has meaning.

When I am told by such men, that they have seen rank crops of clover grow on poor land by a top dressing of marl in the spring, it proves that this *tap-rooted* plant does not require the ground loosened down four feet deep because that tap-root has been found to go to that depth.

Plaster sown on the growing clover in May has been known to produce an astonishing crop. Such fertilizing cannot even reach the lateral roots.

A top dressing of ashes will often cause a crop of white clover to spring up like magic.

When I see seventy corn-fields, in one day's ride, that will average more than seventy bushels of shelled corn to the acre, and not a bushel of weeds in any of them, the inference is that clean cultivation has something to do with the crop.

At the conclusion of Dr. Trimble's paper, the club, upon motion of Mr. A. S. Fuller, amended by Mr. P. T. Quinn, voted to make the subject in hand the special order at half past one next week, and that all shallow plowing farmers shall be heard first, and after them the deep tillers, and then shallow ones again.

APPLES FOR THE PRAIRIE STATES.

Mr. R. P. Spear, Cedar Hills, Iowa.—Frequently the remark has been made by members of the club and others, to whom farmers look for information, that old orchards are dying, or that younger orchards of apple trees do not grow or bear as they did formerly, except in certain sections of the different States. We will admit that the remark is true. But the apple is the most valuable of all fruits, and why is so little being done by horticulturists to ascertain the causes of decline in orchards in the older States? Fifteen years ago we had the general cry in Iowa, Wisconsin, and other parts of the west, that apples could not be grown on our bleak prairies. Our first orchards failed, because such varieties as Rhode Island Greening, Baldwin, Rambo, &c., were planted. But our most persevering nurserymen and farmers did not despair. When a variety failed they threw it aside and tried others. And now we can plant an orchard on open prairies, and know that with proper cultivation and care we will have plenty of fruit in the future. Our nurserymen cannot boast that they have 200 or 300 varieties of the apple, but they can say that they have one dozen varieties that are adapted to our soil and climate. These do well without timber for a protection against winds, but do better with it. We know from experience that some varieties require a stiff clay subsoil, while other varieties are at home on our deep prairie loam. Many years ago a large part of the eastern, middle and New England States was covered with timber; the soil was new and rich. Canker worms, borers, &c., were scarce. But now the reverse is true. Then many kinds of apple trees flourished; now, in the changed condition of the country, a reasonable man would expect very few to do well. Before planting orchards, farmers should determine what varieties of trees are adapted to their soil, their climate, and that will thrive without the protection of the vast forests that existed in former years. Then all who wish to be rewarded early for their labor, should strike from the list varieties that are not early and profuse bearers. But a variety that lacks the quality of early bearing, may prove to be most valuable in the end. A northern slope is best for an orchard, but the first requisite is ground thoroughly drained. Except on the point of ground and tender limbs, trees first show the effects of a severe winter immediately above the collar. To protect the roots and lower part of the trunk from the effects of sudden changes in the weather, or water standing near a tree, throw up a small mound of earth or

well rotted manure around it in late autumn, and remove it after winter shall be past. An orchard should be plowed each year in the opposite direction from that in which it was plowed the previous year, and the furrows should always be thrown toward the trees. By and by the trees will stand on mounds and from twelve to twenty inches deeper than when planted. They will thrive and bear fruit when trees standing on flat ground will look sickly or die. Train trees moderately low, and plant the ground between rows with potatoes or other crops that require similar cultivation. Trees require less pruning on an open plain than when well protected by mountains or timber. On the ordinary prairie soils of the west, north of forty-two degrees, the following list of trees will give satisfaction, to wit: Dutchess of Oldenburg, Tetofsky, Sops of Wine, Red Astrakan, Haas, St. Lawrence, Fameuse, Alexander, Sweet Pear, English Golden Russet, Perry Russet, Blue Pearmain, Ben. Davis, Tallman's Sweet, and Hislop.

Pickles and Vinegar.

Rev. T. Clarke, Flint, Mich., wants information as to the best mode of making and preserving pickles, when a prime article is wanted. He also asks how to make a substitute for cider vinegar without the use of acetic acid.

Mr. S. Edwards Todd.—For making pickles, the following recipe is recommended by high authority in matters of this kind: "To each hundred of cucumbers add a pint of fine salt and cover with boiling water, after which let them stand for twenty-four hours. Then take them from the brine and wipe dry and clean, taking care not to break the skin. This being done, they should be packed in the jars or vessels where they are to be kept, boiling vinegar poured over them, and the vessels closed perfectly air-tight. If flavoring spices are used, they should be boiled in the vinegar before the latter is poured upon the pickles. The pickles when prepared in this manner will be ready for use in about a fortnight, and vegetables commonly used for pickling may be put up in the same way." For making vinegar without cider there is probably no better way than to use a solution of sugar in water, in about the proportion of a pound of sugar to a gallon of water. This, if allowed to ferment after the manner of cider, is capable of being made into a sharp vinegar, the strength of which will be sufficient for all ordinary purposes. Molasses may be substituted for the sugar when desired. Vinegar cannot be made in any case without acetic acid, because

vinegar is simply a solution of this acid mingled with more or less of foreign substances. The chemistry of vinegar making is this: The saccharine matter in the cider or other liquid absorbs oxygen from the air and is converted into alcohol, and then the alcohol unites with more oxygen and becomes acetic acid. Vinegar that contains five per cent of pure acetic acid is the strongest ever known in the trade; and an article that, by testing, would show three and one-half per cent, would doubtless be quite strong enough for pickles.

Adjourned.

January 12, 1869.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Care of Sweet Potatoes.

Mr. F. G. Carey, Buckeye Farm, Butler county, Ohio.—It may not be amiss before I give you my method and experience to say something of the physiology or peculiar structure of this tuber. It will account for what to many seems so mysterious and difficult in its preservation. By examination you find it made of thread like filaments surrounded by a delicate cellular tissue. These filaments run longitudinally throughout the entire potato, and are filled with milk, or milk and water, which on breaking will be seen to exude very quickly and profusely. These filaments form a bundle at the stem end of the potato, and are feeders of the tuber, so to speak. These threads, filled in their normal condition with this fluid, when the potato is exposed to a temperature of twenty degrees, thirty minutes, become enlarged or swollen by reason of that remarkable law, according to which water increases in volume at this hygrometric point of its temperature, and are ruptured, and discharge their contents into the tissue while more or less contracted, and the potato decays at once. The same result is liable to follow from sudden dampness. The sweet potato, therefore, in an atmosphere at any temperature from thirty-two degrees to thirty-nine degrees, thirty minutes, will soon decay. And this is in perfect conformity with the law above stated. Numerous experiments have convinced me of the correctness of this statement. The Irish potato is entirely different in its structure, being composed of cells of uniform density, and is preserved at any point above freezing. Now, my experience for many years has been, if you place your sweet potatoes in bulk, as you do your Irish potatoes, in the place

where you design to keep them when they are dug, without drying them, with no more care in putting them away than the former, and keep them uniformly at a temperature of from forty-five degrees to fifty degrees, you will be as successful with these as with the others above thirty-two degrees. I say forty-five degrees to fifty degrees so as to prevent them going below thirty-nine degrees, thirty minutes. Two points then are only to be observed, viz., dryness and the temperature above given. Putting anything between, among or around them may serve to keep them at the proper temperature stated, but it is of no value whatever aside from that; and if dampness is thereby retained it will be a positive injury. To be a little more explicit, for the benefit of those who may desire to keep the sweet potato, I would say, dig your potatoes before the soil reaches the temperature of freezing on its surface. The mere blackening of the vines will not of itself destroy the potato for keeping, the cells not suffering rupture; but it is safer to dig them before this occurs. As you dig, place them where you intend to keep them, say in a bin or box, the more the better, not to be handled till you remove them in the spring, observing closely the two things above recited. After the sweat takes place, say in some three or four weeks, which may be readily observed, scatter a light covering of dry loam or sand, loam is preferable over them, simply covering them. By following this receipt you may keep the sweet potato for table use, or for seed, as well as its inferior and less nourishing edible, the Irish potato. In South Carolina they put them up in heaps, as we do the Irish potato, in the open air, scattering the leaves of the pine over them, and then covering with about four inches in depth with their sandy loam, leaving an aperture at top for the moisture to escape, closing when the sweat is off. Many in that climate are unsuccessful, and from the same cause, as the temperature falls below forty degrees and they neglect to close the openings. It is a matter of surprise that while our grains, fruits, and vegetables have been submitted to a close and exact chemical analysis, the sweet potato has been omitted, at least so far as my investigation has extended. It has greater fattening properties, and is more nutritious than the Irish potato, and is greatly more productive.

Dr. Isaac P. Trimble.—There is a difference in the soil and climate as between South Carolina and New Jersey. The southern potato is the sweetest, but they raise excellent sweet potatoes in Gloucester county, New Jersey. The farmers there are fully

impressed with the importance of keeping a warm temperature. One grower has a stove in his wagon, so that the potatoes shall get no chill in going to market.

Mr. P. T. Quinn.—In the south they have the sweet potato and the yam; in New Jersey, the sweet potato only. In the south they plant whole tubers; at the north the vines are started in a bed and cuttings or shoots transplanted.

Mr. Henry T. Williams.—In Delaware they plow only three inches deep, and yet raise fine potatoes. The Delaware sweet potatoes are better than the southern.

Dr. Miller.—I doubt whether Delaware potatoes are equal to those from the south. If a market man has the Delaware potato for sale he will say they are better than the southern.

Mr. T. C. Peters.—Judging from my observations while at the south, the people there were very successful in that section in preserving the sweet potato. They put them in barrels with holes in the bottom, which permitted a circulation and gave a vent through which to carry off the moisture. The potato was thus preserved in prime order for family use.

Dr. Isaac P. Trimble spoke of the difference in climate between South Carolina and New Jersey. He said one of the most extensive producers of the sweet potato in Gloucester county adopted very much the plan suggested by Mr. Carey, who carried the caution with regard to the proper temperature to such a degree that he had stoves placed in his wagons in which he removed his sweet potatoes to market. The curious spectacle might be seen any day in winter of his wagons on their way to market with the smoking chimney-stacks of locomotives. There once prevailed an idea that sweet potatoes required a very deep soil, but that was now exploded. All competent to form an intelligent opinion preferred a short and thick sweet potato, raised in a shallow soil, to a long and slim one raised on a deep soil (applause); another argument against deep soil plowing.

THE MERCER POTATO.

Mr. N. C. Jessup, Westhampton, Suffolk county, L. I., sends to the club a sample of Mercer potatoes. The seed was from Maine; has been planted here four years; they do not rot, and improve in quality every year. There were three lots planted year before last; they did not rot when every piece of the old Mercer rotted. They yield as well as any potato that we have. I measured twelve rods of ground, and they yielded at the rate of 325 bushels per acre.

Dr. Isaac P. Trimble expressed himself delighted with the information contained in that letter, and asked: "If we can get the Mercer back again, who wants to pay fifty dollars apiece for these new fangled kinds?"

Dr. F. M. Hexamer, of Newcastle, said, in relation to the improvements of old varieties, that all late improvements had consisted in originating new varieties, which could be more profitably cultivated than the old kinds. Hardly anything had been done to perpetuate the old kinds. No one could dare to run down the Mercer potato; but if it could not be raised profitably, that ended the question. The failure of this kind of potato was not, as had been often alleged, attributed to the practice of planting the smaller bulbs, and using for domestic purposes the larger ones. The speaker had planted large ones, and yet they rotted. Whether the transfer of a certain kind of potato from one section to another, from one class of soil to another, might operate in preserving the produce from decay, was a very important question, and one that entered largely into this question now under discussion. The speaker quoted instances where the esculent improved vastly by its being transplanted from one soil to another, and also cases where it degenerated. As a general thing, Dr. Hexamer believed that the transplanting of a potato from a heavy soil to a light, friable one, tended to improve the quality. There was no use in trying to raise potatoes through a fifty dollar seed if Mercers could be raised at 325 bushels to the acre; but if a fifty dollar seed would give you the means of raising a fine healthy potato to take the place of a sickly one, then the money could not be better expended.

Deep and Shallow Plowing.

The chairman announced that the subject of deep and shallow plowing would be resumed, and he proclaimed that if any one had anything further to offer on the subject of shallow plowing, in addition to what Dr. Trimble had adduced the previous week, he would now be heard.

Mr. H. B. Smith stated that the Farmers' Club in Connecticut valley, several years ago, recommended deep plowing, and the farmers took the advice and plowed several inches deeper than usual the succeeding season. The result was a failure of crops, and from that day to this, the farmers in that valley would call an advocate of deep soil plowing a stark naked fool. [Great laughter.] He (Mr. Smith),

however, was not quite terrified by the result. The first year he plowed four or five inches deeper and lost all his crop. After that he altered his *modus operandi*, and plowed an inch deeper each year, with the happiest results. The point in deep plowing was that it should be done gradually. It was the greatest possible preventive of the evil effects of drouths, and in that lay the greatest argument in favor of it. The contrariety of opinion on this subject arose, Mr. Smith thought, from the experiment having been tried on different soils with different results, each experimentalist making out the result of his experiment to be universal.

Mr. Swift explained what kind of soil might be plowed deep, advantageously, and where and when shallow plowing would be much better than deep plowing.

Mr. T. C. Peters.—I was on the committee that visited Salem county, as a kind of fifth wheel, and I am a good deal of the same opinion as the gentleman from Massachusetts. The expediency and inexpediency of deep or shallow plowing depends upon surrounding circumstances, and upon the nature of the soil to be operated. In the sandy parts of New Jersey shallow plowing is most unquestionably the best. There is one question the club ought to settle: What is deep plowing, and what shallow?

Chairman.—I suppose three inches is shallow, but what may be called deep plowing is quite another question.

Dr. Isaac P. Trimble.—Eighteen inches may be called deep plowing.

Question by the Chairman.—How deep do farmers ordinarily plow?

Mr. Jas. A. Whitney.—About ten inches.

Mr. S. E. Todd.—Very few farmers plow as deep as that.

Mr. T. C. Peters.—In my opinion, five inches and under is shallow; over five inches is deep. In western New York they have a system of plowing the first year five inches for the purpose of planting corn; the next year deeper again; and the third year eight or ten inches for wheat. Such a plan would not hold in New Jersey, where the very best farmers will only plow deep enough to cover their manure.

Dr. F. M. Hexamer.—We ought to define our terms. The average depth is five inches. All below that may be called deep tillage, and less than that and five inch plowing should be considered shallow.

Mr. Cowing, of New Orleans, spoke of the southern soils. He said the subsoil of most of the Louisiana plantations, when first thrown up, is sterile, and weeds will not grow the first year. But afterward, the earth being sweetened by sun and air, the places where earth of

ditches'-bottom has been thrown out will be more productive. He considers it an established truth, that on heavy, tenacious soils, deep tillage is always salutary, and quite often on sandy loams, especially when the climate is likely to bring drouth. A corn field in Texas, plowed a foot deep, will give a fair yield, though no rain fall on the growing crop.

Mr. Swift.—The principle to guide us in New York and vicinity is the quality of manure. With much manure till deep. But much depends on climate and season.

Mr. D. B. Bruen.—I will give the experience of a neighbor of mine, a market gardener. He takes $1,000 and $1,200 worth from an acre each year, uses 175 and 200 loads of manure per acre, and plows just as deep as he can get the share into the subsoil. By this deep tillage and high manuring he has made himself rich.

Mr. P. T. Quinn.—I have watched this discussion with peculiar interest, because I have always been a believer in deep tillage. The views I advance are not from reading. Library farmers make fine theories but bad crops. My farming experience in the red clay of New Jersey is of many years' duration, and every year I am more and more thoroughly convinced of the soundness of the system that has, for nearly a quarter of a century, been followed on the Mapes farm. That system found me poor, and by it and nothing else, I have been enabled to rise, to save money, and to reach competence. On much of that farm I have a soil of twelve inches; and for six inches below that the earth is mellow, and, as Mr. Whitney has found, well supplied with organic matter. Here Mr. Quinn read a letter from Prof. Geo. H. Cook of the State Geological Survey. He says in substance, that the Salem soil and subsoil are both remarkably light and porous, unlike most of the State, and not requiring to be subsoiled to admit the roots of crops.

Mr. John C. Thompson, of Staten Island, gave his views on the intimate connection between good plowing and a proper condition of the soil as to moisture, as follows:

In discussing a question of such vast importance to the human family, one that involves so much extra labor to both man and beast, and one that involves the greater production of food for the human and brute family, as that of deep tillage, it is of the utmost importance that we start right, and keep right on the question before us. And, therefore, the first thing we should inquire into and definitely settle, is, what condition of soil suits our growing crops best; whether wet,

dry or a damp soil? To me it appears that equal moisture is the very best condition to insure the most favorable success to our crops. Now if we find after careful examination that equal moisture is the most favorable condition to promote the growth of plants, then the second consideration is, how shall we proceed to secure that condition for our growing crops? First, let us observe the operations of nature, our great teacher. Let us see what it is that restores the parched-up grass on hill-tops and their sides after a long drouth. Let us see what it is that restores our sun-browned meadows and our withering corn to life after a long drouth in summer. Does not the first passing shower which saturates the parched earth, gives drink to the thirsty plants, alter their appearance as quick as if done by a magic hand. Thus it is seen that water is the food that sustains and restores all vegetation, and if properly supplied to plants, produces the most favorable and satisfactory results; water, without which all animals as well as vegetation dies. Water is therefore the great agent of production, as well as destruction, excess of water being quite as fatal to our crops as the want of it. Now, to get rid of water when in excess for the use of plants, and to secure a supply of moisture for plants when there is a deficiency of falling rains, and thus secure equal moisture, is the gist of the question before us to-day. Close observers notice that hard packed earth, like our roads, dry out quicker and deeper than the cultivated lands beside them. It is also a fact that frequent stirring of the soil in times of drouth causes it to *retain* as well as to *attract* the moisture from the air, and thereby keep it in a damp and more suitable condition to promote the growth of plants. On all our cultivated lands there is annually applied about the same average quantity of manure. But if the season is dry, the crops will be deficient in proportion to the lack of rain. While in seasons of moderate and frequent rains we never fail to have good crops, even without manure, and so it is when we have an excess of wet, the crops are drowned out. That is, on all grounds not trenched, subsoiled, or underdrained to absorb or carry off the excess of water, except on sandy lands (like those in Ocean and Salem counties, N. J.), where the excess of rain passes down without any artificial aid. The advantage of deep tillage, therefore, not only keeps the ground in prime condition as regards moisture, but it renders it fine and friable, which is highly favorable for the fibrous rootlets to ramble through in search of food and drink. It is a demonstrated fact that all grounds stirred deep aid the moisture from below to rise more readily toward the sur-

face, and thereby secures equal moisture in times of drouth, at the same time assisting the earth to absorb heavy falls of rain. As truly observed by friend Greeley, that when he plowed his hillside land six inches deep, large quantities of the soil were carried down by heavy rains to the brook below; but when he plowed twelve inches deep, *none ran off*, because the loose condition of the earth to so great a depth enabled it to swallow up the heavy falls of rain. In conclusion, let me say that I have seen a good crop of potatoes gathered in a very dry season, from a piece of trenched ground when a piece beside it planted at the same time proved a complete failure. I have seen a splendid crop of clover grown (without manure) on a piece of land filled in with clay and sand. On a piece of new land, filled in several feet with clay only, I have seen a fine crop of potatoes grown (without manure). These facts show us that deep tillage secures equal moisture; and equal moisture is sure to reward us with good crops, even when rain-falls are few and far between. How to secure and retain equal moisture in our cultivated soils, with the least possible cost, is a subject well worthy of deep consideration by all tillers of the earth.

Dr. F. M. Hexamer.—My experience in plowing has taught me to go down, but to go slowly, year by year, not all at once. Now I have a depth of about ten inches. When I have plowed deepest the difference in the vigor of the growth was apparent at the distance of half a mile, and the yield was a half more. The hour for adjournment approaches. I wish we could, in parting with this topic, give the farmers of the country two or three conclusions of some practical value to them. May I not state them somewhat as follows:

1. On most light soils of from three to five inches in depth, where the subsoil is mellow and porous we would not advise plowing deep.

2. But on stiff soils, where the subsoil is also heavy, it seems proven that the farmer should carry his tillage a little lower every year until his soil is at least twelve inches deep, and he need not cease his penetration till he reaches the depth of eighteen inches.

As to the best time for effecting this amelioration, I recommend the fall for the deepest plowing. I would go down, for instance, seven inches in the fall and six inches the following spring.

Mr. J. B. Lyman.—When the committee sent to Salem county made their report, portions of the soil were brought to the rooms of the Institute, as also specimens of the soil and subsoil from the farm of Prof. Mapes. These earths were placed in the hands of Mr. Whit-

ney, with the request that he make a comparative analysis of them and report upon their mechanical and chemical character. As a proper introduction to the question in hand, I call for the report of our chemist.

Mr. Jas. A. Whitney.—Mr. Chairman: With reference to the samples of subsoil from the "Mapes farm" and from Salem county N. J., submitted some time since for analysis, the writer regrets that the imperative pressure of other engagements temporarily interrupted the investigations at an early stage. He is, however, able to lay before the club the results of the tests as far as made. Both of the samples were very dry when taken in hand. That from the Mapes farm was so hard and compact as to require considerable effort in pulverizing it in a mortar and possessed a brick-red color, due, as was shown by testing with the ferro-cyanide of potassium, to the presence of peroxyd of iron. The tenacious character of this subsoil indicates that in its natural condition it must present a strong barrier, not only in the downward passage of plant-roots, but also to the drainage of water from the surface soil, and the alternating influences of frost and warmth. More than this, the decay of any organic matter that may exist in the subsoil out of the reach of air, would abstract oxygen from the peroxyd, and thus convert it into a protoxyd of iron, a mineral very injurious to all vegetable growth. Subjected to the usual tests this subsoil gave of organic matter, 51–1000th, or a little more than five per cent. The soluble portion included in this amounted to only 6–100 of one per cent. The proportion of mineral matter soluble in water was 35–100, or slightly more than one-third of one per cent. The sample of Salem county subsoil consisted of yellowish, friable earth, easily crushed to powder between the fingers, and showing in its structure a far greater proportion of silica than the other. It contained 3 65–100, or upward of three and one-half per cent of organic matter, and of this three-tenths of one per cent were soluble in water. Of soluble mineral matter it had one and one-fourth per cent. The sample from the Mapes farm was taken from a field that for years had been subjected to the deep tillage for which that farm has become celebrated, and the extent to which plants are encouraged by this system to send their roots deep into the ground for nutriment is shown by the large amount, about five per cent, of organic matter or humus indicated by the analysis. This is evident if we consider alone the mechanical structure of the subsoil, hard, compact and tenacious, and presenting in its

original state what we may infer to be an almost insuperable obstacle to the pushing downward of the tiny spongioles of plants. When the tough subsoil is loosened it is permeated with minute roots, which, as the plants die or are harvested, commence to decay; but being partially shut out from the access of air, their decomposition is proportionally slow, and hence the humus or decaying organic matter accumulates in the subsoil where it serves a double purpose. By its continuous decomposition the humus gives off carbonic acid gas, which being held in solution by water gradually acts upon and liberates the valuable mineral substances so that they may be readily assimilated by plants. It also absorbs the ammonia carried down by rains from the manures applied to the surface soil and prevents it from being washed away and lost. The percentage of soluble organic matter may be considered in this connection as simply the guage by which we can estimate the relative rapidity with which the decomposition of vegetable substances take place in the subsoil. It will be observed that the quantity of soluble organic matter is greater in the Salem county sample than in that of the Mapes farm; and from this we may infer that in it the organic matter decays more rapidly than in the other, and also find the cause of the smaller percentage of insoluble organic matter in the same sample. The whole is explained by the looser texture of the Salem county subsoil, which permits the more energetic action of air, heat and moisture. These, the results obtained at the early stage at which the experiments were suspended, are laid before you with no further expression of opinion than this: That, incomplete as they are, they furnish proofs of the propriety of *both* of the widely different modes of tillage pursued in the two sections from which the specimens of subsoil were taken. The subsoil of Salem county is loose and friable, permitting the roots of plants to grow easily to unknown depths; sufficiently porous to admit deep down the action of the air, the warmth of the sun and the free drainage of surplus water, and yet it is dense enough to filter the fertilizing materials from the water that carries them into the soil. It offers no inducement to the farmer to plow a foot deep, when nature herself has loosened the ground to a greater depth than his team can ever draw the share. On the other hand, the hard and tenacious subsoil of the Mapes farm, bearing, when dry, a closer resemblance to a brickbat than to cultivatable earth, requires a far different treatment. Its owner was wise when he sought, by the aid of art, to bring about in his cold and sterile subsoil those

very conditions of looseness and warmth with which a kindlier Providence has blessed the fields of his neighbors in Salem county, New Jersey.

Mr. T. C. Peters offered the following resolutions, and moved that they lie on the table:

Resolved, That in the opinion of this club, deep plowing will be considered above five inches in depth, and shallow below five inches.

Resolved, That deep culture is advisable in tenacious soils, while shallow culture is advisable in poorer soils. Carried.

NEBRASKA.

Mr. T. C. Peters read the following letter from Mr. R. R. Folsom, Attica, Wyoming county, N. Y.:

"In your published proceedings of the Farmers' Club of the American Institute, the State of Nebraska is noticed, and its merits and demerits for emigration are discussed. I feel it a duty to correct some of the erroneous impressions that have gone forth to the world. I went out to Nebraska in September, 1854, after the organic act of Congress for making Kansas and Nebraska territories became a law, but before the Indians had given up possession of any part of Nebraska.

From Chicago west 500 miles, to the Missouri river, we traveled a great part of the way without roads as there were then but few settlers in Iowa, more than fifteen or twenty miles west of the Mississippi. We were twelve days in making the trip from Chicago to Council Bluffs. An early frost had killed vegetation throughout most of the eastern States, and the first green grass I had seen for two weeks was on the west bank of the Missouri, where the beautiful city of Omaha now stands.

In the spring of 1865 I commenced farming in Burt county, forty-five miles north of Omaha. I settled at Tekamah, where Tekamah creek disembogues from the bluffs, opening into the broad and fertile Missouri valley, four miles from the nearest point on the great river.

We commenced plowing on the weed land on Tekamah creek, where one yoke of good oxen could plow an acre a day; but the prairies, where the grass is predominant, require more strength of team. We raised a fine crop of corn, some garden vegetables, and a fabulous crop of potatoes; we buried them as we do in western New York, and found most of them frozen in the spring. But little snow fell, and the ground froze to the depth of about three feet.

The next year we had excellent corn, potatoes, and all kinds of garden vegetables. About the middle of May I procured two bushels of seed wheat; spring wheat. Winter wheat does not generally do well there; and this was the first sown in the State north of Omaha. The wheat came up finely, but soon hot, dry weather came on, and, when ready for harvest, the wheat was about two feet high, with short heads, and not very well filled; it had hardly littered at all, and I gave it to a neighbor. He harvested it and got eight bushels. I concluded Nebraska was not much of a wheat country, and did not feel like trying it again the next year; but some of my neighbors procured seed and sowed early in April, and had fine crops; twenty and twenty-five bushels to the acre. Since that time we have all been raising wheat, and the yield has steadily increased, and two years ago the average crop in Burt county, as in several other counties north and south of the Platte river, has exceeded thirty bushels to the acre; while individuals have raised from forty-five to fifty bushels to the acre for whole fields. Hon. William B. Beck, of Burt county, raised forty-nine bushels to the acre, on seven acres, and it weighed sixty-four pounds to the bushel. Much of our wheat for the last three or four years has gone to St. Louis, and brings ten to fifteen cents more per bushel than any other spring wheat that goes to their market, and I can assure you the flour is better than any I have ever seen, except the best quality from white winter wheat. Our Nebraska wheat has already created quite a sensation at Washington; and I must here suggest that, if any parties are wishing for information about Nebraska, they had better write to the patent office, or the St. Louis millers, especially on the subject of wheat-growing in Nebraska. This much in reply to Mr. Tewksbury's extinguisher on Nebraska as a wheat-growing State. I doubt if there is a State in the Union that equals Nebraska as a natural wheat-growing state. Mr. Tewksbury informs the club in a very positive and off-hand manner that he knows all about Nebraska, and that it is the last place he would go to stay. He is probably one of the happy few who have no reason to emigrate. I will now briefly answer the inquiring members of the club from my stand-point, having lived in Nebraska most of the time for more than fourteen years.

I think Nebraska an excellent place to emigrate to; its climate is much like New England, though more dry and generally much less snow; very little rain in fall or winter; it is a very healthy country;

there is an abundance of pure water and pure air, but little timber; timber planted there grows very rapidly.

Cotton-wood, black walnut, and locust are planted most. Cotton-wood grows sufficient for fire-wood and fence-rails (poles) in four or five years, and locust from the seed grows sufficient for fence-posts in six or seven years. The Platte valley is a fine country for 200 miles or more west of the Missouri, but not equal in richness of soil to the Missouri valley and the bottom lands on many of the smaller streams, where the soil is from ten to twenty feet deep, and is a rich black mould where any crop after it fairly covers the ground will not suffer by drouth, as the heavy dews and the porous nature of the soil always keep it moist. A drouth in the fall never injures any crop.

FRUIT.

Northern Nebraska has not as yet been proved to be a very good apple or peach country, although some very fine apples and peaches have been grown there. There is a great abundance of wild strawberries, raspberries, gooseberries, plums, and grapes. The plums are of several varieties, and some of them are very delicious. The gooseberries are very prolific, and fully equal to the best I have ever seen cultivated. The grapes are the fox; small, but of fine flavor, and make excellent wine. Several of my neighbors in Burt county make from five to ten barrels of this wine almost every year. These grapes are the variety so highly commended by the late Mr. Longworth as making the richest quality of wine.

HOMESTEADS.

Good homesteads can be obtained by going to Nebraska early in the spring, and in many desirable neighborhoods, where neighbors are near and where wood can be had at moderate rates. Good bargains can be had by those who have money to invest in improved farms. The Union Pacific Railroad Company will offer their most desirable lands for sale in the spring; and, unlike Mr. Tewksbury as I am, Nebraska is the first place I would advise my friends to emigrate to. If you want to escape pinching poverty, be somebody, and do something for yourself and your posterity, go to Nebraska and see the long, high, and wide cribs of cron, stacks of wheat and oats; see the sleek cattle and horses, fat pigs and flocks of fowls that surround those who went there seven or eight years ago with scarcely a dollar, and then if you don't like it don't locate there.

Growing Sage for Market.

Mr. A. Ingraham, Virgil city, Mo., writes that he has to pay one dollar and forty cents a pound for dried sage, and thinks that its culture must be profitable, and he wishes to know how it is grown, how to dry and prepare it for market, and what yield per acre may be hoped for.

Mr. J. B. Lyman.—Sage is a perennial plant, and should be grown in rows and cultivated in the same manner as onions, the plants being in small clusters about twelve inches apart in the rows, with a distance of two feet between the latter. Sage should be cut before the seed is thoroughly ripe, and must be dried in the shade if the finest quality is desired. In putting it up for market it is best to press it into square cakes covered or wrapped with paper to keep out the air. The price of the seed in New York city is three dollars a pound.

Fertilizing for Wheat.

Mr. Geo. M. Hagans, Morgantown, W. Va., writes: I would like to be informed of the effects of unleached ashes upon wheat, the quantity per acre, manner of and time for application upon a mellow and somewhat sandy loam.

Mr. J. B. Lyman.—The action of unleached ashes as a manure for wheat would be the same as with other cereal grains, viz: To stimulate the growth of straw and leaves, but in a minor degree the development of the kernels. As to the quantity, anything less than a hundred bushels to the acre will do no harm, provided it is sown upon the land in the fall so that it may be intimately combined with the soil by the action of the rain. The best way of applying ashes, especially when a large quantity is used, is to spread them uniformly by means of a broadcast seeding machine. When guano or similar manures are to be used upon the same land as the ashes, the latter should be applied some time in advance of the manures, otherwise the ammonia will be liable to be discharged from its combinations by the action of the uncombined alkali of the unleached ash.

Gathering Sumac.

Several correspondents speak concerning the gathering and drying of sumac leaves for market, and ask for information as to how the leaves can be disposed of.

Mr. J. B. Lyman.—There is only one economical use for sumac leaves, that of tanning leather; and any good tanner, especially of the finer grades of leather, should be willing to pay a fair price for

them. Sumac is, however, mainly used in the preparation of morocco. The leaves are beaten or stricken off from the branches with sticks in July and August. After a long period of dry weather they are much richer; they are then suffered to dry in the sun, and the dealers prefer that they should be ground to a coarse powder before being sent to market. The value of the material varies very much according to the locality where it is produced, that grown in New York and other northern States being worth about forty-five dollars a ton, while that from Virginia and the southern States, sells for twice as much. The market for sumac is mainly among the manufacturers of morocco, of whom there are several in Lynn, Mass., Philadelphia, Penn., and Wilmington, Del.

ITEM IN THE HISTORY OF PLOWS.

Mr. Charles Smith, Pinesville, Pa., writes to contradict the current belief that Jethro Wood was the first to introduce the cast iron plow in America. He says: "This may be true with regard to New York and New England, but I think that we in Pennsylvania can show some claims to the introduction of good plows into this country. My father, Joseph Smith, of Bucks county, Pa., made patterns of plows during the revolutionary war, and some years afterward had four cast from them, and it was with one of these that I learned to plow. This was between the years 1796 and 1800. He obtained the patent while Congress was meeting in Philadelphia, and made plows for sale in 1798. Some years he made as many as 300 plows, which were sold in Lancaster county, in this State, in New Jersey, Delaware and Maryland. I attended the great plowing match at Watertown, N. Y., in 1820, where two of Smith's plows were entered in competition with the New York plows and received the premium. Jethro Wood and my father had a correspondence about the improved cast plows, after the expiration of my father's patent. I think this was in 1816.

CHEESE MAKING.

The same correspondent mentions a method of making cheese followed in his family upward of thirty-five years ago. According to this plan, as soon as the milk was strained the rennet was added, and the curd made. The curd was laid by in the milk room until enough was accumulated to make a cheese, when it was put into the press in the usual manner. The writer says that the cheese made in this way was of better quality than that now commonly offered for sale.

Adjourned.

January 19, 1869.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

How Weeds Originate.

Mr. J. W. Vanderburg, Victor, N. Y., asks the club to discuss the source of weeds. He speaks of the often noticed fact, that after the ground has been broken to a considerable depth, or the earth thrown up from the bottom of a pit or a well, new and curious weeds make their appearance on the surface thus exposed. He speaks of his experience with the Canada thistle, and says he has mastered it with clover. Cut clover and thistle together about the 20th of June. Then cut again when clover seed is harvested, and plow under in the spring when the plants are feeble.

Dr. Isaac P. Trimble.—The seeds, alike of useful or noxious plants, are carried to great distances by birds. The down of thistle grains floats it afar. I have often killed birds at different times of the year, and found in their craws the seeds of apples, of wild roses, and sometimes of weeds.

Mr. P. T. Quinn.—There is a class of seeds, the oleaginous, that keep in vigor a great many years when buried. In sinking a well I have seen rag-weed, spring up rank on earth that came from a depth of ten feet, and had no mixture with the soil. White clover offers another example. While the soil is poor and lacks potash it will not grow, but add manure, and it will spring up at once.

Dr. J. E. Snodgrass.—Will some gentleman tell me why white and not red clover will spring up when land has an accession to its fertility?

Dr. Isaac P. Trimble.—When Prof. Mapes was with us he often spoke of manures being in a progressed state. As I understand that word, he meant that a substance might be in the soil in abundance, but in such mineral condition, so compounded with other inert matters, that plants can make no use of it. This is true of potash. In a granite soil there is an abundance of potash, but often not in a progressive state. The addition of a small quantity of manure that has a solvent power may release that potash, and white clover will spring up. Red clover is more dependent on lime for its growth, and lime is not so readily released from its combinations as potash.

STRAIGHT OR CROOKED FENCES.

Mr. George R. Clark, of Lavina, N. Y., asks whether the difference in consumption of material, when fences are straight rather than crooked, is enough to deserve much attention.

Mr. J. B. Lyman.—In regions where fence timber is good but not plenty, and iron not costly, an excellent fence is made by boring a three-fourths inch hole four inches from each end of the rails, and laying them straight, one on the other, and passing four or five feet of telegraph wire through the holes. This locks the fence together, and makes a durable and cheap fastening. It is used especially with swamp cedar, which is an uncommonly straight timber.

THE DESICCATION OF THE SWEET POTATO.

Mr. Jas. A. Whitney.—Mr. Chairman: It will be remembered that some time since the subject of desiccating sweet potatoes was referred to me. I will now report the results of my investigations. Owing to the difficulty of obtaining a suitable drying apparatus, the gentleman most interested in the invention was unable to furnish more than a small quantity, about six quarts, of the desiccated tubers. This had been very rudely prepared by peeling and slicing the potatoes, and then drying them in one corner of a lumber kiln. The sample was of course too small for extended experiment, and its quality not as good as may be obtained by the use of the best made desiccating apparatus. It was placed in competent hands and proved sufficient, on a small scale, for trial in several branches of cookery. In its crude form, the desiccated product consists of thin slices or disks of dry, starchy material, containing a distinct taste of saccharine matter. The characteristic flavor of the sweet potato is lost, and, with the exception of a slight sweetness, the substance has no more taste than ordinary flour. For this reason the material can never be successfully substituted, as has been proposed, for the canned and preserved vegetables used on shipboard for prevention of scurvy and similar disorders. For this purpose vegetables must retain their original properties in a good degree, as we find in sour-krout, condemned vegetables, etc., instead of being converted into a simple material for flour as in this instance.

An immersion of the dried potato in cold water for several hours produced no apparent effect upon it, and although it yielded more readily to boiling, it was only when ground to a fine powder that its capabilities as an article of food were shown. From this we reach

the definite conclusion that if the product should become a staple article of consumption it must be in the form of flour or meal.

Three experiments were made with the powdered desiccated material with the following results:

1. Used alone in the same manner as corn-starch or flour it produced a pudding equal in every respect to a common bread pudding.

2. Mixed with just enough, and no more, of wheat flour to make the particles of the powder stick together, fritters or "pan-cakes" were made from it in no way inferior to those made wholly from wheat, and much better in the desirable quality of "browning" well.

3. Mingled, as in the case last mentioned, with a little wheat flour, it was made into biscuits resembling Graham bread in color, but having a sweeter taste and finer texture. The writer estimates the quality of these biscuits as somewhat higher than that of ordinary *rye* bread.

Reasoning from these slight experiments, the writer does not hesitate to say that the dried sweet potato, properly prepared, is capable of being used to a very great extent as a substitute for ordinary flour, and thus becoming the foundation of a new and important branch of productive industry, and of proving a boon to that large proportion of our fellow beings who, above all things, pray to see the price of food reduced. The invention or discovery, whichever it may be called, is yet, however, only in the germ, and before any such results can be realized, the processes involved in the preparation of the desiccated tubers must be improved, and the methods of using the product for various purposes in cooking and bread-making must be better and more widely known than they are now.

The essential thing in the preparation of the dried or desiccated sweet potato consists in the removal of its moisture in the quickest way, with the least heat and at the lowest cost. The first step is to remove the skin, which would otherwise not only constitute an impurity in the product, but by confining the steam generated from the moisture in the tuber, would retard its drying and impair its quality when dried. There can be but little doubt that the potatoes could be very rapidly peeled by mechanism designed for the purpose, much as apples are pared. After being peeled, the tubers should be cut in slices of uniform thickness, in order that they may all dry very nearly alike; and these slices should not be more than one-fourth of an inch thick, so that the watery particles may be readily expelled by the heat.

This slicing can be done by slightly changing an ordinary root cutting machine to serve the purpose.

The potatoes thus sliced will be ready for drying or desiccation; and the construction of the kiln for their reception, will be found of very great importance in securing a high grade of excellence in the desiccated material.

The most common form of kiln is that heated simply by a stove and provided with perforated shelves or drawers for holding the substance to be dried, or with a slatted floor covered with a coarse, loose cloth, and designed for the same purpose. Many different apparatus have been made on this principle for drying fruit, and such a one would probably answer well for preparing the sweet potato on a small scale, but would be too slow and variable in its operation for extended use. Another method differs from that just mentioned in this, that the air is heated by external means and instead of moving upward, is caused by a suitable arrangement of flues, to pass downward through the material to be dried. This prevents the moisture with which the air may sometimes become surcharged from being condensed upon or reabsorbed by the material.

There is a third plan, also involving the use of hot air, and which has been tried with success in desiccating the common or Irish potato. It consists in rapidly forcing streams of heated air through the mass of material by mechanical means. The air takes up the moisture very quickly from the mass and carries it away. This appears to be the most efficient of all the hot air methods, and the only objections that can be urged against it are the possibility of heating the air so hot as to injure the substance when nearly dry. The expense of the appliances required to produce the air blast, and the great loss of heat resulting from the high temperature at which the air leaves the kiln, is large. To obviate some, at least, of these drawbacks the writer would suggest a method, which, as far as he is aware, has never been put in practice for the purpose. This consists simply in evaporating the moisture from the material *in vacuo*, by which the heat need not be raised to more than 150 deg. or 160 deg. Fahrenheit to secure its thorough expulsion. The heat should be applied externally to a drying chamber furnished inside with slatted shelves, or preferably with a rotating reticulated cylinder, for holding the sliced material, the air, and also the steam as fast as generated, being drawn off from the drying chamber by appropriate mechanism, in the same manner as from the vacuum pan of a sugar apparatus. The

material would, as a matter of course, be rapidly dried, without the possibility of burning, and without any change in its saccharine matter as might occur at a high heat.

When the sliced tubers have been thoroughly dried it only remains, in order to fit them for sale or use, to convert them into flour or fine meal. This can be more effectually accomplished by grinding in an iron mill. The disiccated product is very hard and tough, and will be far more likely to yield to the disintegrating agency of hardened cutting plates than to the mashing and crushing action of burr stones.

This statement would be incomplete without mention of another use to which the desiccated sweet potato is capable of extended application; that of a substitute for coffee. Broken into coarse pieces, roasted and ground, it forms the closest imitation of real coffee that the writer has ever seen. Unprincipled dealers will be very likely to adopt it as an adulterant, and it would be a good idea if it was placed in the market under its proper designation, so that people might purchase it at a fair price, and use as much or as little mixed with the true coffee as they should find desirable.

As a pendant to the subject more immediately in hand, the writer would mention that another and quite different plan of desiccating the sweet potato was proposed some years ago, in which the potatoes were first cooked and afterward dried. Thus prepared they were claimed to be fitted for transportation, without deterioration, to any part of the world; but whether the method was ever put in practice he cannot say.

In closing this paper, the writer would express the opinion that not only the sweet potato but many other kinds of vegetables may be converted by desiccation into valuable commercial articles of food. He would urge further experiment in this direction, not only because of the profit that would inure to those who may make useful discoveries of this character, but also for the good that must result from them to the community at large. If that man is a benefactor of his race who, as the old saying goes, makes two slender grass blades spring up where only one grew before, how much more is he whose efforts can meet, even in the least, the world's increasing outcry for bread.

Wintering Sweet Potatoes.

Mr. David Dutton, Richland, Keokuk county, Mo., says there is no difficulty in keeping sweet potatoes dry and mealy all winter. He spreads sand on a kiln, and makes it perfectly dry, then packs the pota-

toes in barrels, pouring the sand in till all the intervals are full. The barrels are kept in some room where it never freezes. Instead of barrels he sometimes uses boxes of uniform size, so as to make a smooth wall. When piled up on one side of the room where the fire never goes out in winter, this wall of boxes may be papered over, and stands undisturbed till spring, when such potatoes will command the highest prices.

Mr. P. T. Quinn.—The soil and climate of the south are admirably adapted to the growth of this tuber, and if the south can but see a way in which the sweet potato may become an article of commerce, a great many million bushels will be raised.

Fruit in the Northwest.

Mr. C. H. Greenman, Milton, Wis., spoke of the conclusion to which many years' trial had led him as to the fruits best adapted to the region he represents. He lives between forty-two and forty-three degrees, and finds five varieties of apples hardy and productive: the Fameuse, Red Astrakan, Tallman Sweet, Duchess of Oldenburg, and the English Golden Russet. The Perry Russet and Flemish Beauty are pretty good in Wisconsin. Of grapes there is no use in trying anything there but Concords and Delawares. In strawberries the Wilson is the favorite. The soil of orchards should be covered in winter with some coarse grass or straw for mulch. The weather in the latter part of February and early in March is sometimes unreasonably warm. The mulching stops the mischief that ensues when the ground is suddenly thawed out and as suddenly frozen solid again. The grape vines taken down and covered with earth, were mostly killed, while those covered with a coarse mulch were unharmed.

Mr. W. S. Carpenter coincided with the remarks of Mr. Greenman; and stated that the Duchess of Oldenberg and Tallman Sweeting were excellent varieties for our own locality. The Red Astrakan was superseded by the Summer Queen. The varieties mentioned are very prolific, the trees are hardy, the fruit excellent, and always commands a remunerative price in market.

Pear Culture.

Mr. H. Boise, in Pennsylvania, asks for advice on this branch of pomology.

Mr. P. T. Quinn answers him and says: Sow the seeds of pears in a rich soil. When they spring up and are a few inches high, bud

them; plant in rows and let them grow a year, then top them, and when the lower growth is vigorous, they are ready to be transplanted. For general culture, the Bartlett, Duchess and Sheldon are recommended. Two or three other varieties are favorites. Much depends on soil and climate.

INEXPENSIVE ARTICLES OF FOOD.

Mr. Barney, a gentleman doing business at No. 116 John street, showed the club a tin vessel so shaped as to fit into a common teakettle. In this, Indian mush can be cooked with small expense, and thus poor people, with little outlay for fuel and no waste in cookery, can have sound and good food. He spoke of the wasteful habits of our people in throwing away the head and feet and part of the legs and tails of animals. Seven thousand ox heads are thrown away every week. One can be bought for ten cents, and there are on and in a beef's head sixteen pounds of good nourishing flesh. He says that when you give a poor family a dollar they will spend it for baker's bread and meat at twenty cents, of which a third wastes in trimming and cooking, when twenty cents laid out in corn meal or crushed wheat would give more nourishment. The poor who have no thought or thrift about these things must always remain poor.

COTTON SEED AS MANURE.

Mr. Clarke Swallow, East Bridgewater, Mass.—It is stated that cotton seed is the best manure for corn. It is very good for corn on moist and heavy land; it has no equal for early potatoes, strawberries, and grapes. I have had the early Goodrich on my table, full grown, in ten weeks from planting. They were very smooth and mealy, and yielded one bushel from eight hills. This is a large yield for this place. For strawberries, the vines should be nearly covered over with cotton seed in the fall; it keeps the fruit clean and nice. I had one Concord vine that did poorly, bearing very little fruit, and ripening late. I put one bushel of cotton seed around the roots and near the stalks in the fall. The next fall I gathered five bushels of good grapes, and they ripened seven days earlier than the other Concords, and took the first premium on a specimen of those grapes at the Plymouth county agricultural fair that fall. I have used cotton seed for manure for twenty years with good success. It should be left out over the winter in small piles.

MODE OF PLANTING CRANBERRIES.

Mr. Jones Griffith, Hammonton, N. J.—I have in thorough preparation my swamp for cranberries, and the question with me is, which is the best way to set out the plants, whether with sand or without? Usually, some three or four inches of sand is spread over before setting, but this evil results from this plan: many laterals grow and spread in many directions without taking root at all, and finally rot. Now, to prevent this, I have an idea of setting my plants without sand for the first year; the second year to put on some one and a half inch, and the third the same; believing that by doing this the laterals will take root much more readily.

Mr. J. B. Lyman.—Cranberry culture is in its infancy. Some of the best growers are putting two or more inches at first, and adding an inch each year after a large crop has been gathered.

HOW TO CRUSH BONES.

Mr. R. S. Warthen, Sandersville, Ga.—I have gathered up several thousand pounds of old horse and cattle bones, and do not know how to pulverize or prepare them to apply to cotton. I want a cheap plan.

Mr. J. B. Lyman.—As he has so many it may pay for him to buy a mill suitable to crush them. But as this outlay would be considerable, the advice of the club is: Set a large caldron or kettle in the ground, and fix over it a cannon ball or other heavy round weight, suspended between two hickory springs, so that the ball will be lifted two or three feet after each stroke. Two boys can work the pestle. Break up the bones with a sledge-hammer, and then pound them in this big mortar. This will make a fertilizer that will act slowly, but its effects on the land will be seen for many years. If a quick acting manure is wanted, the better way will be to convert the bones into super-phosphate. Dig a shallow dish-shaped pit, and line it with clay. Pack the bones in snugly, and pour upon them about one-third of their weight of oil of vitriol, which had better be brought by the carboy. The bones will be reduced to a kind of paste. This should be mixed with, say an equal quantity of dry loam, and placed in the furrows when the cotton is planted.

ASHES AND SLAKED LIME.

Mr. Wm. G. Roberts, Racine, Wis., says: I am hauling to my land from the city washed ashes from a soap factory. With these ashes

are mixed a great number of bones of cattle. I mix this material with waste slaked lime, which I get for nothing, and I intend in the spring, after I plant my corn, to take my wagon between the rows and drop say half a spadefull at every hill. Will the club please inform me if there is any virtue in such ashes and slake lime for land that has been considerably run down by grain crop for twenty years, and if there is some better way to apply this compound, and what amount will do? Is half a spade enough? The land is well manured also in the fall, which I intend to plow.

Mr. J. B. Lyman.—Unless the soil is very moist the use of the lime will not be of much value; in any event one bushel of lime to three of the other materials will be sufficient. To apply half a spadefull of the ashes, &c., directly to each hill at planting will simply result in burning up the sprouting corn, and will do more harm than good. It will be better to apply the materials broadcast on the surface after having thoroughly harrowed in the manure. If you do this you can use three times the quantity per acre as by the other plan, and still make it pay.

High Flavored Maple Sugar.

Mrs. C. Swain, South Bend, Ind.—The best way to retain the flavor of maple sugar. Pack it in air-tight chests or boxes made to hold from fifty to 500 pounds, the sugar to be stirred off fine or caked, but boiled till it breaks brittle on snow or on an ax-edge before stirring or caking. Maple syrup to be very fine must be of the "first run," and sealed in jugs or cans while hot. Like fruit, it can be kept very well in kegs or casks the same as Orleans syrup, but not so fine flavored as in smaller jugs.

Plastic Slate for Roofing.

Mr. Jireh Bull, Ballston Spa., communicated his experience with plastic slate. He says: "Our gas house in this village is a one story brick building thirty by sixty; it was built in 1860. Four years after the works were put in operation, I became an interested party. My first visit to the building was on a rainy day; instead, however, of finding it a refuge from the storm, an umbrella was found as indispensable for protection inside as outside the building, on account of the roof. Upon inquiry I was told that two warranted roofs, sure, had already been put on and paid for, and it was deemed inadvisable to expend any more money for that purpose at present. Having at that time but one-sixth of a vote, the roof continued to leak. Two

years thereafter my vote had increased to a majority, and in September, 1866, the plastic slate roofers were at work. They covered an area of 2,467 feet, for which the gas company were charged eight cents a foot. You will readily infer, therefore, the licensees did not work for a puff. It was feared for more than a year after the work was done it would turn out just as the former two had done, entirely useless; that it would not harden; that the heat of the gas house and the natural heat of the sun would dissolve the material and cause it to wash from the roof. Time has dissipated all our fears. It is now twenty-seven months since the plastic slate roof was put on; not a drop of water comes through; and just before snow came this winter, in company with the superintendent, I went on, and examined it thoroughly. It is as hard as flint, and just about as likely to burn as that material. I also regard it with great, very great favor, because it is as perfectly fire-proof as a roof can be made. At No. 229 William street, in your city, is a rear building. For more than a quarter of a century it has been used as a tenement building; it has a flat roof, which offers the only means for drying clothes. During this period it has been an object of no little annoyance. Its expense can be computed by hundreds of dollars, and it possesses no permanent advantage. Two years ago I employed a plastic slate-roofer to go and see what he could do; he put on it a roof, and charged me $100 for it; since then there has been no complaint, no tinkering, and no money expended.

The Way to Set Out Apple Trees.

Mr. Daniel Harrington, Tionesta, Forest county, Pa.—After reading the proceedings of the Farmers' Club, I thought I would make a remark regarding the decay and barrenness of apple trees. In the spring of 1840 I set out an orchard of apple trees in the common way, by digging a small hole just large enough to hold the roots of the young tree, then putting in the tree and filling up the hole around it. The orchard was set out on creek bottom, sandy loam, and cultivated sometimes in corn and oats, with intervals of seeding down to clover and timothy. About half are now dead; of the balance, some bear every year and some every other year. I am satisfied that the reason of trees decaying, and not bearing, is found in the fault of the first setting out; for instance, when young trees are removed from the nursery they are taken out of a soil highly cultivated and manured; they are then set out

in the usual way by putting the roots down in the subsoil, a soil destitute of all vegetable matter. Is there any wonder that the tree does not thrive, or that one-half of them die? About six years ago a neighbor of mine set out an orchard of grafted trees from the Rochester nursery, State of New York, as follows: He put them on high ground, and dug holes three feet in diameter and two feet deep. He filled the holes with stones broken with a sledge, giving a layer one foot or eight inches deep. He then covered the stones with the soil taken from the holes, mixed with compost or well rotted barn-yard manure, and set in the trees on this surface, and filled up around the tree with the best sod that he could get, putting the subsoil as far from the tree as possible. Those trees are the cleanest, thriftiest trees, and grow the fastest of any in the neighborhood, although they have had no attention in the way of washes or manures since they were set out. The reason is that after a heavy rain, or the melting of the snow in the spring, the water drains off through the stones, leaving the roots free from cold water; the roots, also, do not go down into the subsoil, which is destitute of all vegetable matter. I have myself set out some twenty-five apple trees in this way, which, although too young to bear, are growing very nicely. It is a great deal of extra labor to set out trees in this manner, but I believe it will pay in the end, because the trees grow so much faster, and are not so liable to be attacked by insects. The worm or borer does not attack a thrifty tree, but works on the tree that is dying or in the state of decay.

Mr. S. Edwards Todd.—Mr. Harrington is undoubtedly correct in supposing that transplanting from one kind of soil to another, and especially from a rich, warm surface soil to a cold and infertile subsoil, lies at the bottom of much of the unfruitfulness and early deterioration of the trees, and his suggestions concerning the drainage of surplus water from around the roots are well worthy of being kept in mind. The expedient he describes, however, would be efficient only while the trees were small, as the roots would soon spread far beyond the area of the stones underneath. The best plan is to locate the orchard either upon land naturally drained or that subjected to a thorough system of under-drainage. There is no branch of farm production that promises greater profit in the end than that resulting from thrifty orchards, and it is well for the farmer at this season of the year to consider the different bearings of the subject; select the location for the trees, and choose the varieties best suited

for his soil and climate. As the work of setting out the orchard belongs to the season of spring, specific directions as to the minutiæ of transplanting will be more timely a few weeks hence.

TREE CURRANTS—DESTROYING INSECTS.

Ebenezer Akin, Fairhaven, Mass.—I will answer some inquiries made by the Farmers' Club at one of their meetings lately. First, as to raising currants like trees. I have a number that are over an inch in diameter. In the spring I take shoots of the previous year's growth, and cut off the buds that would come under the ground when the shoots are set. I cut them so that they will not sprout. I then sharpen the ends of the shoots and stick them in the ground. Where the buds were cut off they will send out roots without sprouts. I keep the growing shrubs well pruned. Upon the whole, however, I think the old bush way, with judicious pruning out of the oldest and some of the youngest wood, is preferable. There is a fly that deposits its eggs near the top of the stalk, which eats in and destroys the pith for the whole length of the stalk; but I don't see that it hurts its bearing, only that the stem commonly breaks off where the worm eats out. I see that some one of the club recommended searching trees, in the fall and winter, for the eggs of the caterpillar. I have only two apple trees, and when the caterpiller forms a nest on them I take a pole and sharpen the end and wind a rag around it, and wet it well with whale oil or petroleum, and with this I destroy the nest, and it is never rebuilt. I have seen the caterpillars several rods from the trees, crawling on the ground, after being dispossessed by this treatment. These caterpillars are very injurious on cultivated fruit trees, but the wild cherry and beach plum are their favorites. Some time ago I sowed a little tobacco seed close around the trunk of an apple tree, and since then no borer has touched the tree. I have bored into the heart of a tree when I knew a borer was at work and filled it with tobacco. I would ask if a pipeful of tobacco in a tree will injure the fruit. The favorite trees of the borer are the locust and the quince, the latter of which it has almost annihilated in this section. I will state another item. A few years ago a bunch of peach plums, within a stone's throw of my garden, was covered with caterpillar's nests. I poured a little whale oil from a lamp trimmer on a large number of nests and they were soon all deserted.

Mr. S. Edwards Todd.—Where quantity and quality of fruit are the main considerations, the old or common method of growing

currants is doubtless, as our correspondent says, upon the whole the best, but a few plants trained "tree fashion" if well taken care of, are well worth the trouble they cost, if it is only for their ornamental appearanee. Whale-oil soap is an old established and comparatively safe remedy for insects on plants, but petroleum should be used with great care on most kinds of vegetation, or it will injure the latter as well as kill the insects. There is no reason to suppose that tobacco plugged into the wood of a tree would exert any deleterious effect upon the fruit, neither is there any to believe that it would hurt the insects. Even if a portion of the essential principle of the tobacco should be carried into the circulation with the sap, it would be in such small quantities as to amount, practically to nothing. The advice to search out and destroy the nests of vermin on trees at this time of year was good, not only because the nests are more easily discovered when the branches are bare of leaves, but because farmers have more leisure now to attend to such things than at any other time.

Adjourned.

January 26, 1869.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Fruits, Manures, etc.

Mr. Philemon Stout, Cotton Hill, Sangamon county, Ill.—I have read the reports of the Farmers' Club for several years with a great deal of interest, and, I think, profit. But I can hardly realize, here in Illinois, why it is that there is so much of the time of the club devoted to the subject of manure, while there are thousands of loads on our farms going to waste, though I do not consider it good farming. We invite our friends from the east, who are seeking locations, to come to Sangamon county, Ill., for there is plenty of room for good farmers; where we can raise from fifty to 100 bushels of corn to the acre, and other crops in proportion, and all the fertilizers we need is red clover, which will grow as well, perhaps, as any place in the world. My orchard has been in clover eight or nine years, and has been mowed twice a year, and the clover looks strong and vigorous; and I have another field sowed with clover and timothy, half of each, which has been pastured about seven years, and the clover has almost entirely taken it. Those fields, I think, are better than when the prairie sod was turned. Apples are very fine; I keep my trees free from all insects by washing them once a year, in May, with strong tobacco tea,

made strong with soap. Farms could be bought, from four to twelve miles from Springfield, from forty dollars to seventy-five dollars per acre, according to the improvements. Good free schools in every district. I have written more than I intended, but thought I would tell my eastern brother farmers some facts in regard to Illinois.

Some discussion ensued about clover being advantageous in orchards. The majority of speakers seemed to regard it as harmless.

In regard to manures, it was stated that Illinois stood below New Jersey in the average acreable product of corn. The reporter thinks the people begin to appreciate manure, for he saw many farmers drawing manure from village stables to put upon their corn land, up in McHenry county, last spring, and they told him there was no land in Illinois that they knew of which would not be benefited by manure.

The opinion was expressed that the corn was generally badly cultivated, and that the fault was more in the labor than in the land.

Mr. J. B. Lyman cited the authority of a lecture lately read before the Illinois Industrial University for the statement that rich and fresh as the soil of that State is supposed to be, the average crop of corn per acre is less by nearly one-third than in poor, despised New Jersey. The average for the United States is twenty-five bushels an acre. In Illinois, with a soil and climate precisely adapted to corn, the acreage is no higher. In Jersey it is forty-three, in South Carolina six. Illinois ought to give from the most of those deep, rich loams of hers seventy-five bushels of corn per acre. If Salem county, New Jersey, does it, if parts of Monmouth, if the farms of eastern Pennsylvania often yield that much, it is because those farmers are awake to the importance of saving and applying all the manure they can. When Illinois takes the lead of eastern States as a corn-growing surface; when she beats Jersey on her sands, and Connecticut amid her stones; she will cease to wonder why this club is so much in earnest about fertilizers.

Mr. W. S. Carpenter.—They have a practice in those prairie States properly called "hogging." They turn a big drove of hogs into a cornfield, and allow them to eat, and trample, and waste, and defile all the grain they can. No usage can be more at war with a sound and snug system. No wonder their corn and wheat crops grow smaller. One idea casually mentioned in this letter I like. He says he sows clover in his orchards. That is right. Clover draws its food from the subsoil, and its effect is to keep the surface mellow and moist. Timothy is drying in its nature, and will spoil the productiveness of an orchard. I never put timothy among my apple trees.

Sweet Corn.

Mr. James B. Olcott, Buckland, Conn., sent samples and his apology for naming his variety of sweet corn "Farmers' Club." The apology was accepted as was the corn, which was eagerly sought for by members present. He says: The sweet corn question needs a little agitation. The seed stores vend a variety as long as it will sell. They'll take a new kind whenever there is a demand for it. Somebody must show that the old earlies are no longer old enough to make their second rate qualities pass. There are half a dozen old kinds that have outlived their usefulness, and only serve to bring green corn into disrepute. Stowell's evergreen is widely known, but who can vouch for its merits as sold in the shops? I have tried seed from various quarters, but have got nothing but mammoth stalks, and late, tough, tasteless corn. Then there is the whole question of preserving, improving, and hybridizing varieties; all very little understood, and demanding our attention in its way, quite as much as, say, grapes. I prize the Farmer's Club of the American Institute for the kindly ear it gives to wants all over the country. It is a court of appeals. As reported, it helps consolidate the nation, and is a model American institution, to be reproduced as population progresses. I shall always feel a pride and a strength in being one of the least of its outside members, and propose to do nothing to discredit myself. I have been for fifteen years a journeyman farmer and gardener. Have now worked back to my birth place. I have ever felt the greatest interest in your discussions, chiefly for their popular character.

Dr. Isaac P. Trimble.—I have here a dozen or fifteen ears of corn that I do not believe is surpassed by any variety for excellence of flavor. Some years ago I gave out the same seed, and Solon Robinson wrote in such terms of it that I was flooded with letters asking for seed. Then something went wrong with my corn for a few years. But now it is all right. The ears are not the biggest in the world; but no one that has eaten it in its season, will ask for a dish more toothsome or delicious. I will have a bushel of it shelled and left with the Secretary for giving to all who ask for it.

Spontaneous Combustion.

A sample of blackened hay was presented as coming from Mr. David Pettit, of Salem, N. J. He gives the following explanation:

"We have heard much said at times about spontaneous combustion.

I have heard of a barn near Mount Holly, owned by a man named Cole, in which the hay took fire from spontaneous combustion; that the hay settled where combustion commenced, and was extinguished by playing water on with an engine. How true it is I will not say. I forward to-day, by express or mail, a small block of hay cut out of the middle of the mow, where Franklin lives, which you may see has become very much discolored by the heat, which was so great for a long time that one could not bear his hands or feet on it, and it is warm yet; more than six months since it was housed. The hay was not put into the mow very green. Can some members of the American Institute Farmers' Club account for this? You may perceive the hay is not musty, but damp yet, smells like tobacco; the horses eat it, though it has a peculiar strong taste."

Mr. T. C. Peters.—I found, when I was actively engaged in farming, that I could mow away my hay quite green, if there was no rain or dew on it. The natural juices of the grass will not thus play the mischief with it; but if half cured or dried hay is wet and then piled away it will sweat and heat, and become greatly damaged, as this has. It is an excellent plan to throw dry straw over damp or imperfectly cured hay.

Mr. J. A. Whitney.—As to combustion, it cannot take place if the air is excluded. Hence, for damp or greenish hay, tight barns are the best. The ferment through which this clover has passed has robbed it of its strength-giving qualities, but the starchy parts are not so much affected; it will be eaten by stock exposed to the cold, and by young animals, but would be almost worthless for working beasts or milch cows.

Mr. W. S. Carpenter.—Farmers are getting more and more into the way of putting what they cut into the barn the same day; except in rainy weather, it can be done. Greenish hay should be forked into a tight bay, well trampled, salted a little, and have the loads as they come in, sandwiched with a few bundles of dry straw. The straw absorbs the moisture that would work mischief, and in mid-winter that hay comes out so bright and sweet-smelling and hearty that the cows laugh when they get it.

Mr. S. Edwards Todd said he used to cut after noon, with the mower, all that he could rake and cart the next day. Red clover he always cut when the majority of the blossoms were blown. He mowed after noon and after the dew or rain had been dried out of the standing crops. This clover was raked the next day, while yet

damp, and before the leaves dried, and put into cocks, where it usually lay from four to five days, oftener a week; and when carted the cocks were moved for an hour or two before being taken up. He usually filled the mow at one time, because the condensation of the vapors at the top of the mow always made a bad streak in the hay, unless we put dry straw on top to absorb it. Some one suggested salting, but the reporter thinks the practice very injurious to stock, especially sheep, by creating an artificial thirst in cold weather.

Cutting up or Chopping the Food of Neat Cattle.

Mr. Lucius Libby, Saco, Maine.—Several weeks ago the question of cutting hay for horses was brought up and discussed by the club, upon which, of course, various views and opinions were expressed, and because there were those present who doubted the wisdom and economy of the practice. The *American Agriculturist* of December says: "Those who have thought us severe in our criticisms on the Farmers' Club, are referred to the following extracts of the reports:" (Here follows the remarks of Mr. Quinn.) "What would an English farmer think of us were he to step into the club, and find us gravely discussing the propriety of cutting food for animals, and Gamaliel and all the doctors of the law thundering their anathemas against hay-cutters, &c." Mr. Quinn evidently considered this a "settler" of the question, but good authority may be cited to confirm the opposite view. Thomas S. Lang, Esq., of North Vassalboro, Maine, of whom you may learn something by referring to report of Department of Agriculture for 1864, page 157, has made several thorough and careful trials in keeping horses upon cut and uncut feed, and has become satisfied that dry hay and dry grain is better for them than cut and mixed feed; it is more natural for them to masticate their own food; they perform it more thoroughly, and keep in better condition than by any other system of feeding. Physiologists whose books I have read agree in the opinion that human beings should eat slowly, and should not drink with their meals, in order to give the salivary glands time to act, so that the food may become mixed with saliva, as nature designed. Does not this principle hold good, in a measure, with horses? Is not the practice of cutting hay and wetting it, and mixing it with meal, in order that horses may "bolt" it down with very little chewing and in a very little time, somewhat like that in which human animals indulge when they eat their dinners in five or ten minutes, washing their food down with hot tea or coffee, to save

the time and trouble of chewing? And in my opinion the evil consequences in both cases manifest themselves sooner or later by impaired digestive organs and diseased constitutions. If a practice prevails among certain farmers across the ocean, it is no reason why others may not inquire and investigate for themselves; and were Thomas S. Lang a member of the club, and engaged in "gravely discussing" the question under consideration, he would not be utterly dumbfounded if the English farmer aforesaid were to step in upon him unawares.

Mr. P. T. Quinn.—Since my remarks are thus openly challenged I will take occasion to reply as openly, but not to-day. I will collect a mass of facts and give them to the club in a paper to be read in two weeks from to-day. I am sure I can array such experiences as will persuade even Thomas S. Lang, although he has had the high distinction of writing an agricultural essay for government, that true economy and regard for the greatest efficiency and comfort of laboring stock, milch cows, and fattening animals, requires us to cut their food. We all know that the best beef is not that of wild cattle. The gentleman talks of its being natural to all animals to masticate their own food. Man, in a state of nature, is naked; but I notice we are all so artificial as to come here well wrapped in overcoats and furs this cold day. Why isn't it natural to eat raw potatoes? But theorizing is just what we don't want on this subject, and I will give my views not as opinions, but as facts.

Dr. J. V. C. Smith.—While I greatly respect our friend as a farmer and as a cultivated and thoughtful man, I must say that science does not sustain him. All the gramnivora have a long intestinal canal. They have a set of stomachs, they have salivary glands, all of which would be comparatively useless, unless their food were taken slowly and ground between their own molars. I believe I will bring here the maw of a sheep or the paunch of a cow; and by showing gentlemen the labyrinthian convolutions, the honey-comb appearance, and the curious formation by which the food is tossed, so to speak, from side to side of the intestinal canal, I am sure this body will be convinced that hay-cutters are a nuisance, that they debauch and disorder the entrails of our cattle.

Mr. W. S. Carpenter.—While I admire the scientific knowledge of our friend, Dr. Smith, I must say that no array of cows' paunches will convince me or any other practical farmer that hay-cutters are useless. Theory will not persuade a man who has tried cutting his

fodder to go back to long. If a farmer finds, as hundreds have, that ten pounds of cut hay goes as far as fifteen fed long, that fifty pounds of ground and cooked corn is as nourishing as seventy-five fed from the cob, a lecture on stomachs and glands will not convert him.

Mr. Cornell of New Jersey.—One gentleman referred to the difference between wild and tame meat. It so happens that we have just been fighting a malady that started among animals as wild, almost, as deer. The Texas beef we know is not as tender or as juicy as the loin of our well-housed, stall-fed beasts. We often hear high praises of semi-barbarous tribes and half-civilized usages; but in a collision of races and forces, the more cultivated generally carries the day. The more advanced a people become, the finer is their stock, and the more care and labor is bestowed on their food. Hiram Woodruff, for instance, when he wanted speed from an animal, fed him on hay from which every spear of trash had been culled by his own hands. Dr. Smith speaks of slow digestion as necessary for longevity. May I remind him that the lion, the king of brutes, and among the longest-lived, bolts his food almost whole.

Mr. Thomas Cavanagh.—Can we not go to the omnibus and street car stables for a lesson? They would not follow a practice unless they knew it to be sound; and, without exception, all these thousands of horses are fed on cut hay. Some of those horses are thirty years old, and for a generation have worked every day, and thriven all this time on what is here denounced as unnatural and unwholesome.

FRUIT FROM IOWA.

The secretary placed on the table some very choice samples of fruit from D. W. Adams, Secretary of Iowa Horticultural Society, and read the following letter:

IOWA STATE HORTICULTURAL SOCIETY,
SECRETARY'S OFFICE,
WEEHAWKEN, IOWA, *January*, 1869.

American Institute Farmers' Club, New York:

At the request of Iowa State Horticultural Society I, to-day, send by express (charges prepaid) a few samples of Iowa-grown fruit. These specimens were gathered early in September, and consequently were not so highly colored as our fruits usually are; otherwise they are thought to be very creditable to the capabilities of Iowa as a fruit-growing State. As you see them, they also labor under the disadvan-

tages of having lain three days on our exhibition tables at the annual meeting, and of having made a journey of fifteen hundred miles by express. I hope they will reach you in such a condition that you will be able to judge of their quality and external appearance.

I am, with much respect, yours, &c.

D. W. ADAMS,

Secretary, I. S. H. S.

The following is the list of names of the varieties presented. They were a beautiful show of apples indeed, and rarely equaled in any fruit show, and never excelled:

Fall pippin, white pippin, mother, Rhode Island greening, Vandevur, Roman stem, Virginia greening, Pennock's red winter, black gilliflower, Hubbardston nonsuch, Smith's cider, Newtown spitzenberg, Rawl's jannet, Belmont gate, Jonathan, Peck's pleasant, Milam, white winter pearmain, big romanite, white bellsflower, yellow bellsflower, Ben Davis New York pippin, Rambo, willow twig, Fulton, Rome beauty, Dominie, Talman sweet, wine sap, Swaar, Oskaloosa, (an Iowa seeding), Tulpchocking, green sweet, northern spy, little romanite galpin, Esopus spitzenberg, black apple—thirty-seven varieties.

Mr. W. S. Carpenter, who is a large apple grower, commented quite fully on this display. He says the Rhode Island greening is the most universal apple we have growing on a greater variety of soils and under circumstances more unlike than any other. He commends the Rome beauty as a splendid and very marketable apple, also the Dominie.

Mr. A. S. Fuller remarked that all these apples came from the east, and the show is a proof that the apple belt is moving west, for New England nor New York could not to-day get up so fine a spread of large, handsome fruit. Mr. Crane of New Jersey said he lives in a region once famous for its apples; now they have to buy from New York and the west. These apples have flourished because the enemies of this noble fruit, the canker worm, the tent worm, the slug, and the curculio, have not carried their line of invasion across the Mississippi river; but they will, and then Iowa will be calling on the Rocky mountains for apples.

Cattle Diseases.

Prof. John Gamgee, from the Department of Agriculture at Washington, D. C., sends the following communication: The members of

the Farmers' Club may feel interested in knowing that the publicity given to my letter, recently read before them, on the subject of the lung plague of cattle, has placed us in possession of much accurate information regarding the localities infested by that disease. I have to thank the club for the facilities thus offered me, and at the same time trust that this second letter may have a similar effect and encourage others to communicate any facts or transmit any documents relating to the nature and extent of losses by cattle disorders.

On the subject of contagious pleuro-pneumonia I have received valuable letters from several counties in Pennsylvania and Virginia. Indeed, a communication from Mr. Dwight Smith of the Internal Revenue Department has enabled me to trace the lung plague from Washington to Alexandria, and for thirty miles beyond. This city has furnished several hundred dead cows to the contractor employed to remove them, and, although the stabling of cattle in the winter season checks the propagation by contagion, as soon as the warm weather and abundance of grass favor the congregation of animals on commons, the disease will increase greatly in extent.

I am preparing a complete work on the subject for the Department of Agriculture, and in the meantime it has been deemed advisable to publish a preliminary report that the country may know what it suffers and must expect in the absence of all combination for the eradication of so formidable a disease. I herewith transmit fifty copies of this report for distribution by you.

Another malady has been made the subject of several letters to me. It is a form of indigestion, popularly known in England as fardel-bound or "stomach staggers," associated with dizziness, prostration, and even paralysis, and due to the cattle feeding on smutty corn or mouldy stalks. Wet weather and the undrained condition of American soils induce the abundant development of smut on Indian corn, and although a considerable quantity of these diseased stalks may be fed to cattle in combination with other fodder, it is very deleterious, and, in excess, induces a wide-spread mortality. The disease has been reported to me from New York State, Connecticut, Iowa, Nebraska, West Virginia and the Carolinas. Prevention consists in changing the diet. The malady is not incurable. Warm water injections and the internal administration of one pound or one and a half pound of Epsom salts, with four ounces of sulphur and a couple of drachms of ginger in warm water or gruel usually restores the animals to health. Treatment must not be delayed too long.

Several of my correspondents may have felt aggrieved at not receiving prompt replies, but this has arisen from the extent of my correspondence, and the amount of work I have been called upon to perform. I trust this letter may be accepted as an indication that their communications are being utilized for the common good.

All communications addressed to me at the Department of Agriculture will be gladly received, and it may please you and the country generally to know that the Hon. Horace Capron, the Commissioner of Agriculture, is quite alive to the vast importance of these subjects, and aims at the prompt publication of trustworthy reports which may tend to diminish the ravages by epizooties in the United States.

Woman as a Fruit Grower.

Mrs. Mary Dungan, of Elizabethtown, Hardin county, Ky., recommends the region where she lives, forty or fifty miles due south of Louisville, as a remarkable fruit country. She says: I do not wish to lose a single number of my paper while the tillage question is being so ably discussed by Horace Greeley and Dr. Trimble. My judgment inclines me to favor the former, while my pocket may induce me to follow the latter. I was induced to move here by a Louisville merchant, who was at my late residence in Washington county, Pa., two years ago last fall, who could not cease admiring my beautiful bower, loaded as it then was with Concord on one side, and Delaware grapes on the other. He thought I had a taste for fruit, and on his return home posted himself in southwestern fruit regions, and selected this. This region is called Muldrow's or Muldrough's Hill. It is a spur of the Cumberland mountain, 150 miles in length, and the fruit region, but a few miles in width. It is peculiarly adapted to growing the best of peaches and strawberries. Apples, pears, and all small fruits do as well here as in western Pennsylvania. The pear tree has never blighted here. The people here know nothing of the black knot that defied me to grow plum trees and morella cherry trees in western Pennsylvania. I paid $5,500 for 301 acres of land. It has about 150 good bearing apple trees on it, eighteen years old, 1,000 peach trees, four to six years old. I planted last November and December 160 pear, 150 plum and German prunes, eighty cherry, 300 to 400 peach, all of the best varieties; have heeled in for February planting 100 French quinces, 500 best varieties of apples. I set my stakes twenty feet apart in each field, plant quinces, dwarf pears, and plums in orchards by themselves this distance apart. All the apple trees and

standard pear, forty feet each way, planting at the intervening stakes peach; between these twenty feet rows I plant two rows of strawberries, wide enough apart to cultivate, with a cultivator that is four feet, leaving eight feet between the fruit trees and the strawberry rows. I hope in ten years to equal the Knox farm, near Pittsburg. There are hundreds of farms that can be bought on this hill at from ten to forty dollars per acre. This is not a good agricultural region; only seven to twelve bushels of wheat to the acre; twenty bushels a rare crop; thirty to thirty-five bushels of corn. The oat crop this year was as good if not better than it was in western Pennsylvania. Those who may wish to make fruit raising a specialty would do well to visit this region. Come here any time from the middle of August to the middle of September, we have ripe peaches here from the twelfth (I do not know but some of Hale's Early were ripe the first) of July until in October.

HOW SHALL I HAVE PLENTY OF APPLES?

Mr. J. F. Wolfinger, Milton, Pa.—That our apples trees bear less, and also poorer fruit, than they did thirty and forty years ago, is generally true, and as generally regretted. And the real causes of this apple tree failure are, as yet, involved in mystery, and open to dispute. But it will do no harm, and perhaps some good, to notice the supposed causes:

1. Exhausted Soils.

Some say our apple trees fail to do well because they are planted upon old, poor, and worn out, or exhausted soils. This seems to be true to some extent, and the remedy is plain; manure your orchard every other year with barn-yard manure, lime, salt, bone dust, and such other manures as experience has shown to be essential for a vigorous and healthy growth, and a productive condition of the apple tree. Our old orchards, planted many years ago, needed no such manures, because they were planted on *new* grounds, virgin soils, that were rich in all the elements that were necessary for the production of large crops of apples of superior size, beauty, and flavor. And as these elements are now scarce on most of our lands we must use the necessary manures to replace them. But experience and observation have of late years shown that the *new* orchards, planted upon our very best *new* grounds do not grow so thrifty, or bear as plentiful as our orchards did many years ago. And so there must be some *other*

cause, aside from the mere want of manure, for the failure of our apple trees.

2. Change of Climate.

Others say that our apple trees fail doing well because our climate is undergoing changes that are unfavorable to the vigor and productiveness of the apple tree. The orchards of our first settlers were everywhere, and for many years, surrounded with extensive forests and woodlands, as well as swamp and marshy grounds, that kept the air around the apple trees moist, and also warded off the cold and chilly winds of autumn, winter, and spring, that would otherwise have blown upon and injured the apple trees, and their blossoms, and young tender fruit, and so made the apple crop sure, large, and fine. But the draining of these swamps and marshes has dried up this source of moisture in the air, and the cutting down of our extensive forests and woods have left our apple orchards, all over our country, continually exposed to the destructive frosty winds of autumn, winter, and spring, and to the scorching and withering rays of our hot summer's sun, and our increasingly hot atmospheric airs, generally destitute of moisture; and the consequences upon our apple trees, and their crops have thus been, and now are, just what we might reasonably expect from such a change of air and climate. And our only way of avoiding this evil, this increasing evil, will be to surround our orchards with belts of such evergreen and deciduous trees as will ward off these cold winds, and increase the moisture of the air around our trees, and make the air there of warmer and more steady and uniform temperature than it now is.

3. Insect Ravages.

Others say that the failures of our apple trees and apple crops arises mainly from the great increase of destructive insects and their ravages, that injure the trees and make their fruit small, wormy, rotten and worthless. And this is evidently true to some extent. And our only sure remedy against this part of the evil is for us all everywhere to protect and save the lives, and greatly increase the number, of our insect-eating birds that will devour the various insects that commit these ravages on our fruit trees and their fruit. We must increase the number of our insectivorous birds, if we want to increase our supplies of fruit, and secure that fruit for our own use. And hence the man or boy that sportingly, or carelessly, kills an insectivorous bird,

or destroys its eggs or nest is an enemy to the neighborhood where he dwells, an enemy to his own good, and should be severely punished for such bird-killing.

4. Pruning Trees.

Others say that the failure of our apple trees and crops arises from the unwise practice of cutting off large limbs when pruning the apple tree, and doing the pruning in a rough aud haggled manner, and putting nothing on the wounds to protect them from injuries from the air, hot sun, rain, &c. Very considerable injury is done to our apple trees in this way. Of this, no reflecting mind can have any doubts, and such pruning ought to be very carefully avoided. But as our most nicely and carefully pruned orchards fail bearing fruit, as our orchards did many years ago, we must seek the true cause or causes of their failure in something else. I am inclined to think that want of manure and want of proper ground-culture, and the changes of our climate from moisture to a hot, scorching dryness, and the prevalence of insects, are the real causes of our apple trees failing to grow and produce plentiful crops of fine fruit, as our orchards did in generations gone by.

Deep or Shallow Plowing.

Mr. R. Dibble, Branford, Conn.—I always take a great interest in your reports of the Farmers' Club. I was surprised at the position taken by the champion of shallow tillage. All my experience is in favor of deep plowing and subsoiling. Fifteen inches or more has paid me well every time. My farm is of a heavy and wet loam, with a clay subsoil; in many places hard, so that water stands upon it. When I first worked it my father-in-law was in the habit of plowing shallow, four or five inches. He set me to plowing in a square field; I divided it into three lands, plowed the first and half of the next about eight or nine inches deep. When he saw it he said I had spoiled the ground. I then plowed the remainder of the lot as he wished it done, four or five inches. The season was a dry one; the whole was planted with corn; the crop on the latter part was rolled up and nearly dry, so that the crop was spoiled, while the former was not injured at all, and yielded a good crop. He one day asked what made the difference. I told him: "That is where I spoiled the ground by plowing deep." His reply was "Poh! that's no reason." Since then I have experimented at least ten times, and always found a

marked difference in favor of deep plowing. I cut at least fifty tons more of hay, and all the cultivated crops are more than double what they were then, and yet I have not as many acres as he had, nor anything like the capital to work the land. The advance in the crops is due mainly to deep plowing.

Mr. E. Goodrich, Cedarville, Mich.—The God of nature has so dispensed the elements of fertility in the soil, that in some localities they are almost exclusively embraced within a few inches of the earth's surface, and in others they are to be found deep down in earth. Consequently the question of deep or shallow tillage must be met and decided according to the particular organization of the individual field or tract of land under consideration. It is not uncommon that we find a few inches of fertile surface soil, rich in the elements of vegetable decomposition, but immediately underlaid with quicksands or other substances extremely barren of fertility. In such a case the farmer may procure a few crops by plowing from four to six inches deep, but let him plow a foot in depth, and throw down the fertility of the soil to the bottom of a cold furrow at the same time burying up the inhospitable subsoil as a seed bed, and he will find his crop materially diminished. Perhaps his next neighbor, on a different soil, by pursuing the same course may find his crop doubled. Now, if these men are not distinguished for their powers of observation and reflection, each one will "be fully persuaded in his own mind;" and while the one succeeds well by deep plowing and the other by shallow, each will marvel at his neighbor's stupidity, and think that every farmer in order to succeed should do just as he has done. It is so the world over, and perhaps it always will be so, in spite of all that has been or may be said or written on the subject. The fact is that no calling on earth requires more thorough experience, close observation and sound judgment, than that of the farmer. The practice of the farmer must be varied to suit the varieties of soil and all the thousand attending and surrounding circumstances. A farmer may have ten fields and no two of them admit of precisely the same treatment.

Your correspondent, Mr. Snow, of Hanover, Mich., very justly ridicules, the popular idea that plants send their roots deep down into the bowels of the earth in search of nutritious matter not to be found near the surface. Let us devote a moment's consideration to this subject, and, first, let us inquire *what causes a plant to grow?* A plant is in one sense like an animal; both grow upon the strength of

nutritious matter *actually received into the system*, and both perish for want of such nutritious matter when it is not to be found. The plant does not send its tap-root five or six feet down into the bowels of the earth because it has a *presentiment* that somewhere away down in the bowels of the earth lies a bed of gypsum, or some other fertilizing matter; on the contrary, it grows because it receives into its system, partly from the earth and partly from the atmosphere, those elements of nutrition upon which it subsists. To suppose it would grow on any other principle would be to suppose it possessed of that faith described by the Apostle Paul, which is "the substance of things hoped for, and the evidence of things not seen." Why does the pig in your pen flourish and become fat? Is it because he has an intellectual consciousness that you have plenty of good sound corn in the crib three rods distant? Or is it because he eats and digests the corn, and it becomes a part of his bone and sinew, his flesh and his blood? Let every farmer bear in mind that if a plant grows, it is because it has nourishment which it can incorporate into its system, and not several feet below the point of its tap-root in the bowels of the earth.

GREEN CROPS AS MANURE.

I notice that at a late club meeting a discussion was had on this subject, in response to the inquiry of Mr. Bond of Ohio.

One speaker advocates corn, another buckwheat, and a third clover. Now, the inquiry of Mr. Bond was directed to "a soil of clayey loam." On all stiff clayey soils the object of plowing in green crops is twofold. First, chemically to enrich the soil, and second, mechanically to loosen the soil and render it easy of cultivation. If we take into consideration the last mentioned object alone there is, perhaps, no crop better calculated to accomplish the desired effect than buckwheat. Its growth is rapid and luxuriant, and its decomposition is also rapid. While it takes a year or more to mature from the seed a crop of clover, including the stalks and roots, a buckwheat crop can be matured in a very few weeks. The cost of seed, also, in case of buckwheat is small. But if the object is to enrich the soil, then buckwheat is of very little consequence, as it is a well-known fact that there is scarcely to be found a plant which in all chemical elements of fertility is so poor as buckwheat straw.

It is in this great principle of fertilization that the excellence of clover as a green crop is most peculiarly manifest. Few plants are found, upon chemical analysis, to be so rich in ammonia as the clo-

ver, and one of the most noteworthy points of excellence in the clover crops consists in the fact that in its growth it draws more largely from the atmosphere and more lightly from the soil than almost any plant that grows. The atmosphere is a great chemical laboratory, in which are generated many of the life-giving properties indispensable to animal and vegetable existence. Prominent among these properties is ammonia. In every clover crop that is plowed under, a large amount of this valuable ingredient is transferred from the atmosphere to the soil, and the earth is thereby materially enriched. The roots of the clover, by penetrating deep into the soil, operate mechanically in loosening the soil and rendering it porous and pliable. Bassingault has shown, by a carefully instituted series of experiments, that the largest portion of the clover crop is that which grows below the surface of the ground. Hence, whenever a clover sod is turned under, no matter how closely it may have been mown or depastured, the ground is materially enriched.

Next to clover, there is perhaps nothing, as a green crop that is superior to the pea. Like buckwheat it grows rapidly, and like clover it draws very largely from the atmosphere, and but slightly from the soil. It should be plowed under at the time the vine has attained its full growth, and while beginning to blossom. Especially on stiff clay soils will the pea be found valuable as a green crop. Let those who have never tested it give it one fair trial.

Adjourned.

February 2, 1869.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Extent of Plant Roots.

Mr. John McVean, Scottsville, N. Y., writes that farmers and laborers often observe facts in nature which, truly stated, are acceptable to men of science. For example, in June, a few years ago, he had occasion to dig a well in a field of very thrifty winter wheat, through strata of clayey loam soil and subsoil, with underlaying limestone and gravel, and gypseous shales. Fifteen feet down he found a multitude of roots of the growing grain, as large as linen sewing thread and of considerable tenacity. It was also a common thing for men digging plaster on his premises to find clover roots extending twelve feet below the surface, and Mr. McVean, in consideration of the fact that the club, in canvassing the matter of deep

and shallow plowing and drainage, offers these items without comment or inference, as being of possible aid in arriving at correct conclusions.

Mr. Wm. S. Carpenter in reply expressed the opinion that only minor consequence should be attached to the circumstance of plants sending their rootlets down to such depth. My experience, said he, is that the roots which stay near the surface are the ones about which farmers ought chiefly to concern themselves. For there is no question that if these are destroyed the plant will perish. A few years ago a friend set from one to two hundred apple trees in his lawn. The third or fourth summer they began to die, and there was fair prospect that he would loose them all. I visited him and found that the trees had been planted from eight to twelve inches deeper than they originally stood. At my suggestion they were taken up and reset in proper depth of soil, and they are now as magnificent trees as one would wish to see; so with other growing things, even the red clover must not be overburdened with weight of earth and we may conclude that the roots which go deep are of little use to the plant, and are not to be specially regarded by the husbandman.

Mr. S. Edwards Todd.—Some trees, some shrubs, some bushes, some vegetables, and some kinds of leguminous plants, always have a strong and large tap-root. A tap-root seems to be just as natural to those plants and trees as coronal roots are to the stalks of Indian corn. Indeed, let the tap-root be severed from the main stem and the tree or plant will usually cease to thrive satisfactorily, and, in many instances, decay and death will soon follow. Pine trees, and especially the *Pinus alba*, usually have a large and long tap-root. I have seen stumps of small pine trees taken out, each having a tap-root from eight to twelve feet in length. The chestnut (*Castanea*), the black walnut (*Juglaus nigra*), the shell-bark hickory (*Carya alba* and the *Carya sulcata*), and many other trees are so dependent on a tap-root that it is exceedingly difficult to remove them, and have them live and grow satisfactorily, without digging deep and taking up a large proportion of the tap-root without injury, and then transplanting as the roots first grew, as nearly as practicable. Most farmers in all sections of the country understand how exceedingly difficult it is to remove certain nut-bearing trees, and have them live. The tap-root was so mutilated, or removed entirely that the trees never could survive the injury received when they were taken up. Most nut producing trees, and many of the cone bearing trees, like the *pinus strobus* and

the pitch pine (*pinus rigida*), in order to succeed at all satisfactory must be put out when they are very small, or, what is still better, be raised from the seed where the trees are to grow. By pulverizing the subsoil several feet in depth, where it is so compact that the earth cannot be shoveled easily, the tap-root will strike downward readily, and the trees will flourish satisfactorily where they would not grow at all if this precaution had not been taken to prepare the ground for the tap-roots. I know the tap-root is removed entirely, many times, from fruit trees when they are transplanted; and many persons, whose opinion is respected as authority, will always say remove the tap-root of every tree. Some trees appear to thrive quite as well after the tap-root is removed, even with the upper system of coronal roots. But, when it seems to be the habit of a tree, or plant, to send down a large tap-root, the stem will always grow far more luxuriantly if the entire tap-root can be retained, than if it were severed.

Red clover may be cited as an instance, which no one will controvert. It is a habit of red clover, that many other leguminous plants do not have, to send down a large and strong tap-root. Indeed, the transcendent excellence of this plant as a subsoiler, as a civilizer, and renovator of a stubborn soil, depends almost entirely on the tap-root. Let the tap-root be severed near the upper system of coronal roots, and if the plant survives the injury, it will be no more of a renovator of the soil than a stool of timothy (*Phleum pretense*).

All plants and trees, when not growing where sand constitutes the largest proportion of the soil, will throw out a system of coronal or secondary roots near the surface of the ground. If a system of secondary roots were not essential to the requirements of the growing tree or plant, most assuredly such roots would never appear there. If a young fruit tree be deprived of the uppermost system of secondary or coronal roots, another system will soon be sent out just below the surface of the ground, except with old trees. Let the earth be hauled up around a stalk of Indian corn before the pollen has fallen, so that the soil covers another joint above the last system of roots, and in a few days nature will push out another system of brace or coronal roots.

The same is true of young fruit trees. If the roots are transplanted too deep the trees will not grow satisfactorily, until a system of secondary roots has been formed near the surface of the ground. Let the soil be examined around a young fruit tree, where a dressing of

mulch has been spread for a few years, and it will be seen that the ground is literally full of roots near the surface. Let fertile earth be deposited round about a young tree, a foot or more in depth, and in a few years the entire layer of earth will be filled with a mat of roots.

When a small lad I well remember that my father removed a young apple tree, with a ball of frozen earth, in the winter, and dropped the ball with the tree in a large hole that had already been prepared before the ground was frozen. It so happened that the tree was planted several inches deeper than the coronal roots originally grew. The consequence was that this tree barely survived for several years, although it was an English streak tree, which, in that locality, is a prolific bearer and very hardy. A system of coronal roots was immediately thrown out near the surface of the ground, and after a few seasons, as soon as the coronal roots had filled the surface soil round about the tree, the branches were loaded with large and fine apples, and that tree is a great bearer to the present time.

In 1843, the writer ordered a lot of fruit trees from a nursery, at Flushing, L. I., when he was swindled in a provoking manner with a lot of inferior trees, at an extortionate price, which were set too deep. The branches grew very little for several years. But as soon as a system of coronal roots had been formed near the surface of the ground those trees grew rapidly.

A few years ago the mice girdled a young apple tree more than two feet from the ground. A broad mound of mellow earth was formed around that tree, extending above the wound. A system of secondary roots was immediately thrown out of the body of that tree just beneath the surface of the mound.

We may, if we will, derive a profitable lesson from these facts touching the propriety, or impropriety of plowing orchards after the surface of the soil round about the bearing trees has been filled with rootlets. The coronal roots, in some instances, will supply such plant-food and fruit producing material as the radicles, which extend deep into the subsoil, cannot take up. Removing most of the coronal roots with a plow will sometimes injure, temporarily, the productiveness of any fruit tree.

Potatoes and their Culture.

Mr. S. Wilbur, Fairport, Monroe county, N. Y.—I take the liberty to send forward a few thoughts in regard to potato growing, best varieties, etc., etc. I notice that there were some new varieties

brought forward; and, by the way, I am interested in this branch of farming, as I am a potato grower and buyer, and am also located in a potato growing section, Monroe county, N. Y. We send thousands of barrels from this town annually to New York, for table use, and also for seed for the southern States. I believe it an all-important fact that farmers who are growing potatoes for market and for profits, should be posted in regard to the best kinds to plant, not only for profit, but also in point of quality. I believe that the seedling Mercer is the best variety known as a table potato; they also command the highest price in market. For winter use the peachblow stands next in the list, and the white peachblow takes the preference above the red, but the quality is the same. And the Dykeman, for early use, I believe to be the best early variety known. We grow them in this section for seed for the New York market; they are sent south as far as Norfolk, Va., and after repeated trials of other new varieties, it is now conceded that the Dykeman is the best early variety. We have tried the early Goodrich here, and we find that it is not only a common potato in quality, but no better to produce than other kinds. The Harrison is a profitable potato for farmers to plant, but the quality is about like the Goodrich. They will, no doubt, do well where potatoes are liable to disease. The Early Rose seems to be good in quality, and as an early potato to plant in gardens will do, but for market will not compare with the Dykeman.

GUINEA FOWLS.

Mr. Smith, of North Islip, Long Island, solicited information with reference to these turbulent and pugnacious birds, and would particularly like to know how to distinguish the sexes.

Mr. S. E. Todd, in answer to the query, said that other people besides the writer of the letter, had been troubled in a similar way, and he thought that a desolate Guinea fowl all alone on a Long Island solitude would be puzzled itself to tell to which sex it properly belonged. Nevertheless, the question is of consequence, because wherever Guinea fowls are kept, there should be an equal number of each sex, for they pair like pigeons, and therefore Mr. Smith's inquiry is in point. Tegetmire, the author of a valuable European treatise on poultry, says the male of Guinea fowls has a higher casque than the female, and the wattles are larger and of a bluish red color, while those of the female are smaller and of a deeper red. Mr. Bement says there is but one unerring distinguishing characteristic, namely,

the hen only utters the well known cry of "come back." The note or wail, for it is mournful, of the male bird is totally different. He also runs on tip-toe with a mincing gait, which the hen never imitates.

Mr. A. B. Crandall.—A word might fittingly be said just here of the Guinea fowls, which, it is believed, merit more regard than they are accustomed to receive. A chief objection, as has been intimated, is that they are too noisy and intolerant. Barnaby Googe mentioned them three centuries ago as "outlandish birds." This spirit and consequent neglect, said the late lamented C. N. Bement, is very undeserved, as they are, of all known birds, the most prolific layers of excellent eggs. Week after week and month after month sees no, or very rare, intermission of the daily deposit. Even the process of moulting is sometimes insufficient to draw off the nutriment the creature takes, to make feathers instead of eggs, and the poor thing will often go about half naked in the chilly autumnal months a fowl that has escaped from the cook to avoid a preparation for the spit, unable to refrain from its diurnal visit to the nest, and consequently unable to furnish itself with its winter clothing. Thus the body of a Guinea hen is a most admirable machine for producing eggs out of insects, vegetables, grain, garbage, or whatever an omniferous creature can lay hold of.

Tegetmire says the Guinea fowl was well known to the Romans, and bore a high value at the public and private feasts at the time when the luxury of the empire was at its height; and Martin says that like all the gallinaceous birds, this Guinea fowl is esteemed for its flesh and for its eggs, which, though smaller than those of the common fowl, are very excellent and numerous, the hen commencing to lay in the month of May and continuing during the entire summer. After the pheasant season, young birds of the same year are on the table, by no means unworthy substitutes for that highly-prized game. They are not unprofitable birds, as they are capable of procuring almost entirely their own living; still they are neglected by many on account both of their wandering habits, which give trouble, and their disagreeable voice, resembling the noise of a wheel turning on an ungreased axletree. Another English writer of large practical experience says that by a little coaxing and regular feeding with other poultry they may be rendered quite tame even to the extent of perching with them at night in the same roost. Even their continuous clamor for "buckwheat, buckwheat," and their incessant cry of

"come back," "come back," has its advantages, being an invariable sign of approaching change of weather, and frightening the hovering hawk, and thus protecting the whole feathered army of the harem.

Mascall says "they require great attendance, and yee must make their court somewhat hye, set also with bordes agaynst the walles, round about the court in the length, and their perch made to sit where the sunne, and each bird his place." The hens, says the same old author, sit thirty days, and the infant brood must be managed like young turkeys, as they are equally if not more tender.

Plowing Under Buckwheat.

Mr. Joseph Lodge, New York, writes as follows: "In this hasty note I desire to give reasons for plowing under buckwheat as a green crop, in preference to any other as a fertilizer, in any or all lands where humus or vegetable matter has been exhausted. First, it is done at so small expense; secondly, it can be matured for the use required, in from six to eight weeks, according to the strength and fertility of the soil; and by this mode of assisting the soil, two or more crops of buckwheat may be put under before sowing wheat in the autumn. For years I have plowed under buckwheat previous to planting or sowing grass for lawns or pleasure grounds, with good results. I do not discard manure whenever I can get it. But the ground is kept moist and light with the assistance of buckwheat, and all who would practice this method, would find great and beneficial results in wheat, grass and rye."

Mr. S. Edwards Todd.—I must enter a protest against this statement, on account of the pernicious influence which buckwheat exerts on the productiveness of the land. We cannot tell why, but it is a fact, which every farmer of extensive experience will admit, that even good land, unless it is heavily manured, will not yield half a crop of wheat, barley, oats or Indian corn after buckwheat had been grown upon it, and I am bold to denounce it as one of the crops which the husbandman can best afford to do without. Experienced farmers all over the country, in our grain growing regions, understand that a crop of buckwheat exerts a pernicious influence on the productiveness of a fertile soil. Some agricultural chemists have assumed that the roots of buckwheat throw off a poisonous excrementitious material that operates unfavorably on the next crop. But there is *the fact*, whether it can or cannot be explained.

Mr. A. S. Fuller.—This is the first time that I have ever heard

that buckwheat is injurious to the crops that are to follow it. I can see no good reason for such a statement. In central and western New York I have known farmers to put on buckwheat when they wished to grow a large subsequent crop. I think it is to be praisefully spoken of, especially as it grows on land too poor to produce anything else.

Mr. W. S. Carpenter.—It ought to be understood that buckwheat will not have bad effect if the seed is not allowed to mature. The growing plant, in its early stages, takes from the atmosphere the nutriment it requires. For instance, I have seen a fifteen-pound turnip produced in washed sand, merely by the agency of water alone. It is true that buckwheat is an exhaustive crop if it is allowed to mature.

The Farmer and his Work.

Dr. R. T. Hallock read the following paper: The notion is not yet universally obsolete that the proprietor o the first garden which history tells us of had only to sit himself down beneath the luxuriant shade and enjoy the uninterrupted pleasure of admiring idleness. These shallow interpreters of history assume that his dismissal (occasioned by a little ill-advised activity), lost, not only for himself, but for all his posterity, the blessed privilege of doing nothing. They forget that it was expected of him, by way of compensation for his enjoyment, that he should "dress it, and keep it" in good order. It is not unnatural that the over-worked and under-paid man, should imagine bliss and idleness to be convertibl terms; and in the weakness of his sweaty brow and exhausted muscles, should charge our common ancestor with disposing of his inalienable right to sit still much below its true value. These wiseacres might greatly improve their commentaries by considering whether or not nature herself, in a state of perpetual action and hurry of progress, can afford to let a man sit still; whether or not he is related to the grand system of progress which she everywhere hints her aptness for, and to which she responds with all her great heart whenever he takes her kindly by the hand. To answer affimatively is to emancipate labor from the degradation of a curse, and elevate it to the dignity of a divine agent in the work of creation. It is to see man in his true place among the intelligent powers and vital forces by which chaos becomes creation, and order advances onward to perfection.

FARMING LABORIOUS.

But we have to do more particularly with the farmer, using the term in its broadest sense. To him labor is supposed to present some of its most repulsive aspects. Truth to say, he has had a hard life of it throughout his generations; and it is not the easiest occupation imaginable to-day even. His sons have not all ceased to envy the lawyer, who, as it is assumed, in the comfortable shade of his office, has only to write and think; or the clergyman, who has but to preach two sermons on a Sunday; or the merchant, who always has soft hands; or the mechanic, even, who has no corn to husk, or cattle to feed in bad weather. No amount of fine phrases, and these have been showered upon him in profusion, can blind him to the fact that his success is at the expense of hard, muscular labor, and all but perpetual vigilance. Tickling his ear does not afford the most permanent relief to his limbs. Help must come to him from intellect, rather than imagination, from science, rather than poetry. Now, the basis of reformation in all the departments of industry, for which the world waits is dumb, but instinctive expectation, is the ability to place its individuals workers just where the normal instincts of each promise the greatest proficiency. In other words, in any useful work, the first requisite for success, in its best sense, is a natural love for it. The next is the realization of its true dignity. The third is science, which reveals the economy that gives the reward. No manual labor will respond with more success to this threefold power than common farm work. It is not enough to love the smiling landscape, the growing grain, or the proceeds of the annual crops. One may have the love of all these in his soul and be ashamed of it. He may feel their force, and yet reproach himself with the want of a nobler path to tread through life. His labor, as he imagines, though useful, is not the most honorable.

THE FARMER A CREATOR.

This is the mistake which takes the elasticity of inspiration out of his efforts, and degrades his labor to mere drudgery. He needs to realize that there is no other profession in which a man so directly coöperates with God; in which he stands forth so manifestly an agent, or mundane center of the creative power. He is not, if he would but reflect, a mere supplyer of food to the cities, where men are transformed into great lawyers, editors, politicians, merchants, and, noblest of all, millionaires. Oh no! That is not the only part

assigned him in the economy of nature. There is another, which, though incidental to the supply of food and the like necessities, is by no means limited thereby. Beyond that important avocation, there lies a realm in which he enacts the creator. The very existence of the domestic animals crowding the belt of highest civilization upon this globe is due to the farmer! He creates them here. Not out of nothing, to be sure, for out of nothing not anything can come; but their life in our climate is as truly due to him as though their antetypes had never existed. Let him abandon them, and how many, think you, would survive next winter? Nor is their life and perpetuity alone due to him, but their development as well. Compare the noble quadruped to be found in the modern stable with the three-toed brute said to have borne "Cæsar and his fortunes;" or with the shaggy specimens of the equine species still to be found in the wild places of the earth, and know that it is the farmer who has molded that mere bundle of bone and muscle into the stately form you see "upon the avenue." Ring out the praises loud and clear of the artists who create beauty with the pencil or mold it in marble; louder still for the artist, the farmer namely, who molds in flesh and blood, who gives us not only beauty of form, to initiate which is their highest praise, but beauty infilled with life. His marvels of artistic skill have failed to crown him with due honor, only because in the æsthetic nose of genteel criticism his garments smell of the stable rather than the studio. As between the production of a horse, for example, and a copy thereof, in what you will, upon whose brows, I pray you, should rest the artist's crown?

The Farmer an Artist.

But he is an artist in color as well as in form. Who developed that many-tinted, double flower out of the single-leaved, one-hued original? Who created that basket of luscious, blushing peaches, which certain artists in color only so delight to copy? Those strawberries and cherries? Those pears? Miracles of form and color in their way; aye, and of flavor as well. Let him who will, his genius so determining, become an artist in stone or in bronze, in wood or on canvas; but let his admirers not forget that the highest place in all that noble school belongs of right to the successful artist in life. Practically, if unconsciously, he is also a sounder philosopher than the graduates of the modern "development school," who plume themselves upon their descent in a right line from the noble family of

apes; for his genius and skill demonstrate the order of progress and the power of development to lie in the opposite direction to that which obtains with them. Would these gentlemen but study fossils none the less, and facts of the living world a great deal more, they would learn that it is through the farmer that inferior forms and qualities of animal and vegetable life are developed into superior, and that instead of their having the power inherent to carry it on, they invariably go backward in the direction of their ancestral inferiority when his skill and care are withdrawn. Every farm-yard, garden and orchard proves this. The eglantine is not adequate of itself to produce the profusion of beauty and perfume displayed by its relatives of the garden; the ability is with the florist, because the power of development is in him and not in it. There is no power in the bitter almond of the east to become the luscious peach of the New York market. Things don't lift themselves up, nor is organic life pushed up from below. The source of development is intelligence; primarily, Divine intelligence; proximately, human, which is an incarnation of the Divine; and in this, as made manifest by the farmer, lies the power of progress.

THE FARMER AS A POET AND PAINTER.

The farmer, judged by his work, is a poet, a painter, a sculptor and a philosopher. It will be his own fault if he fails to share the honors due to these professions. His poem is infinitely more grand, and the theme more sublime than that of Homer. Its words are things. Its measure is not a mere jingling sound; it is the harmony of beauty and use. Its theme is not the war of Greek with Trojan; it is the conflict of intelligence with chaos. As a painter, his pictures live. He hangs them in the summer air, and the birds love them and the bee extracts their sweetness. As a sculptor, his statues breathe. They need no pedestal; they are self-supporting. They adorn the parks and avenues of cities, and are to be found upon the hill-sides which hide the abode of the unpretending artist, and shut out the honor and admiration which he has so justly earned. Let the world be just. There is no monopoly of art; there should be none in its rewards. There will be none when we become true critics. The dapper citizen in scented gloves, lady on arm and glass in hand, entering the academy of art exhibition, finds it necessary to manifest a furor of admiration over a canvas landscape, a fruit-piece, or a vase of flowers. He must know the artist, that he may honor him with a dinner at Delmonico's. But that green meadow and field of

waving wheat, of which it may be the copy, who made them? Who made those purple clusters hanging from yonder terrace, and near them those luscious pears and cherries with cheeks as rosy as the blush of morning; those flowers, which challenge the rainbow and out-plume the birds; those countless products of vine and briar, of bush and tree, which melt upon the tongue, those triumphs of flavor, such as Roman epicure never tasted; that steed, swifter than the wind, more beautiful than those which mythology attached to the chariots of the sun; "the cattle upon a thousand hills," rejoicing in their well fed sleekness, who created these? Why, the farmer created them. They are the products of his art. Let him stand forth in his own estimation for what he really is, and demand his reward. There may be poor artists in his peculiar school. Such are to be found in other departments of art as well. He may still have to do hard work; so does every heroic worker, whatever his field of labor. He may be fearfully pre-Raphaelite in the getting up of his corn field and potato patch, and put in so many weeds as to greatly mar the effect; he may still continue for a time to set his crop-pictures in very slovenly frames, and carve the statuary of his pig-sty with noses quite too long for high art; but every year brings improvement, and perfection is yet nowhere. He is marching on in his glorious art, and let him take renewed courage, for, "as round and round we run, ever the right comes uppermost, and ever is justice done." And come it will, for the grand pyramid of civilization, whose apex is yet to reach to heaven, has its foundation upon his genius and his spade.

Barley.

Mr. Emmor Walten, of Buckingham P. O., Bucks county, Pa., writes: In consequence of the repeated failure of the oat crop, some of the farmers in this neighborhood are discussing the feasibility of substituting barley in its stead. But it has been so long since any of that grain has been grown hereabout, that no one can be found whose experience qualifies him to give proper directions respecting its cultivation. Buckingham valley is a limestone region, very fertile and highly cultivated, the space between the loamy surface and the rock being occupied by a moderately tenacious yellow clay, strongly impregnated with lime. When the spring is backward and wet there is a difficulty in getting the oats sown as early as desirable. Late sowing and the strength of the soil cause a heavy growth of straw, which falls badly, thereby often reducing the yield one-half, while it

costs the other half to gather the crop; mowing and reaping machines being entirely useless for that purpose. Thus, one of our most remunerative crops has become the least so. If any member of the Farmers' Club, or any reader of its proceedings, can give satisfactory answers to the following inquiries, they will greatly oblige the subscriber, with many others.

1st. Which is the best season for sowing barley, fall or spring? 2d. Are there two kinds of barley, one for each season? 3d. Can it be sown as the next crop after corn (the same as oats), at either season? 4th. How much seed is required per acre? 5th. If sown in the spring does it require less, or longer time to ripen than oats? 6th. If they ripen simultaneously, how will it answer to mix them for the purpose of crossing the stiffer straw of the barley to hold up the oats and prevent its falling? 7th. In what proportions of each should the seed be mixed? We sow from two and one-half to three bushels of oats to the acre. 8th. Is barley a suitable substitute for oats, as a food for stock?

Mr. W. S. Carpenter.—There are two kinds of barley, spring and fall; the fall barley is not so sure, being more liable to winter-kill than the spring. He sowed from two to two and one-half bushels per acre. It yields about like wheat, and ripens two weeks later. Barley requires better land for a fair crop than oats. Don't sow on poor soil.

S. E. Todd.—Barley may be sown with success on soil capable of producing paying crops of corn or oats. It requires thorough tillage and clean culture. Winter barley may be sown in September or October, after Indian corn; but I would advise the sowing of barley in spring. Barley and oats may be grown together; but they must be early oats, in order that the two crops may ripen about the same time. The barley most inquired for is the four-rowed variety; from two to three bushels of seed are required per acre, and it should be put in with a drill. If the straw is liable to be limber, and not sufficiently stiff to maintain an erect position, the best remedy is to plow the land deeper than usual, and sow large quantities of ashes immediately after the seed is put in. If the land be low and rather wet, a bountiful crop of barley cannot be produced until the soil is relieved of the surplus water. If under-draining cannot be done at once, let the plowing be done with narrow lands, throwing up ridges and making deep middle furrows. A great many wet fields may be rendered comparatively dry by making deep dead furrows about

twenty feet apart, and clearing out the loose earth with shovels, so that the surface water will flow away early in the spring. When barley and oats are sowed together, equal quantities of each kind of seed may be put in. But it will be always more satisfactory to raise the two kinds of grain separately, unless the grain is raised expressly for home consumption. Barley and oatmeal are excellent for milch cows or for feeding teams.

Winter Feed of Cows.

Mr. W. T. Place, Ripley, Huron county, Ohio, asks information on this subject.

Mr. J. B. Lyman.—It depends on whether you want quantity or quality from your animals. If you sell your milk by the quart, feed roots and wheat shorts, stirred into hot water, so as to make a rich warm gruel, clover hay cut in June and rowen. If rich milk is your end and yellow butter, feed the blades of corn and sorghum, gathered green and sweet, upland hay, cut and wet with hot corn meal gruel. For roots, use carrots and parsnips or sugar beets, about a peck a day. Feed five times; water often. Keep the animals warm and dry. Never speak a loud or cross word to a cow, and carefully abstain from pounding her hip-bone with the milking stool.

Sumac.

Mr. Milton Barrett, Keysville, Charlotte Co., Va.—Will some member of the club kindly inform me what part of the sumac plant is required in commerce, how it is cured, treated, and packed? This plant grows in luxuriant wildness in Lunenburg Co., Va., and might be cultivated to advantage. Good lands may be bought here, with or without improvements, at from three dollars to ten dollars per acre. The present owners are anxious for emigration from the north, and will treat them as friends. This I can vouch for, having held a Federal office here for the past three years.

Dr. J. V. C. Smith.—In reply to this gentleman I will say that when traveling in Sicily, from which island we receive a great deal of sumac, I observed the way in which it was gathered. The leaves, twigs, and bark are beaten or stripped from the shrubs, dried on the ground or on platforms, and the whole ground to powder and shipped in bags or boxes. In this country the bark and twigs are less used, I believe.

Mr. D. B. Bruen.—The sumac leaves are gathered in the months of

July and August. They are much the stronger after a long dry spell. They are beaten or stripped off, and dried on the ground. Southern sumac is much stronger than northern, and ought to be worth much more. It is used principally in tanning morocco. The best market towns for dried sumac leaves are Lynn, Mass.; Wilmington, Del.; Philadelphia; and Newark, New Jersey.

Cultivation of Beans.

Lewis W. Burwell, Littleton, Sussex county, Va., is anxious to plant five or six acres of the most profitable class of beans. He would also know about the mold of forests, and especially pine forests, so as to use the straw with the most advantage.

Mr. Wm. S. Carpenter.—They will grow on light sandy soils, and yield more profit, considering the soil and the labor they demand, than most other crops. The white kidney bean is the best. Beans will not flourish on a heavy wet soil; thirty bushels to the acre is a good crop. Much of the time they sell in New York and other cities at four dollars a bushel.

Mr. P. T. Quinn.—If his woods abound in forest mold, let him gather it and compost it with stable manure. They aid each other. He should collect pine straw every wet day when his hands cannot plow, and use it, as litter, freely about a yard; it is a substitute for straw, and makes, when rotted, a good manure, especially for potatoes. If he can sell beans as a fresh vegetable, he should by all means choose the Lima, but, for common marketing, the navy white would be best for him. Any manure good for corn or cotton will make beans grow.

When to Cut Grain.

Mr. R. Clymer, of Sidney, N. Y., quotes the recent lecture of Prof. Horsford, as proving that grain should stand till fully ripe. If you cut wheat or rye ten days too early, you lose one-fifth of its nutriment.

Mr. A. S. Fuller.—If farmers would but study the laws of vegetable life, these questions would not puzzle them. In the blade and leaf there is a provision for wastage or going back. But in the grain there is no organism by which the elements can go back out of the kernel into the ground and pass away into the air or the earth.

Mr. W. S. Carpenter.—I have given this subject a good deal of attention, and it will take more than a Cambridge professor, if he is an expert in bread-making, to persuade me to let my grain stand till it is dead ripe. The sign I go by is the butt end of the stalk, the

reach of the straw from the ground to the first or second knot. When that turns yellow it is practically defunct, ceases to be of any use other than to hold up what is above. Then the juices of the stalk above feed the grain a little longer, and they can do it just as well after the stalk is cut as before. So with corn. All I want of it is to be well glazed over, to get out of the milk; but I do not want the kernel flinty all over and hard to pressure as a piece of bone; for before the corn is that firm the blades are as brown as frosted leaves, and rustle in the wind. In that state half their nutrition has gone. But corn gathered at the stage I describe is just as nutritious as though it stood longer, and the fodder is as good as timothy, ton for ton.

Adjourned.

February 9, 1869.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Hay Tedders.

Mr. S. L. Hoxie, Otsego Co., N. Y.—I would like to inquire of the Farmers' Club if the spring-tooth sulky rake is superior to the common revolving horse rake. There are none of the former used in this part of the country. I would also inquire in regard to the practical utility of the hay tedder, and of the best one in use. I would also like some information in regard to the best method of hanging the horse fork. Would it be profitable for a farmer to be to the expense of purchasing either or both the rake and tedder who cuts hay only for a stock of forty cows and a team?

Mr. Horace Greeley.—Without hinting at any invidious distinction between rival manufacturers of horse rakes, I think the general use of the tedder would result in a large and clear gain to the grass farms of this country. Two notable advantages may generally be enjoyed by those who use the best modern tedder. 1. Hay cut in the morning of a clear day may generally, as the rule, not the exception, be put on the mow that afternoon; and, 2. The hiding of the sun by clouds does not materially interrupt the process of hay-making. If no rain falls, the grass may be so actively stirred as to be made into hay with very little hot sun. The result of using these machines must be to put our hay crop into the barn or stack a week or two sooner than before, and in better condition. On these accounts

we cannot too earnestly commend the use of tedders; and in the case of a man who winters forty cows and a team, the policy of buying one is beyond debate.

Mr. J. A. Whitney.—The great objection to the sulky spring-tooth rake is their enormous expense and liability to get out of order. Ordinary farmers find that it requires the skill of a mechanic to keep these rakes in order. Besides they will not do as good work as the wooden-tooth rakes.

Mr. S. E. Todd.—The best tedder is the American hay tedder. There are other very good ones. But the principles lately brought out in this implement entitle it to the first rank among hay tedders.

Mr. H. N. Tracy, of Essex Junction, Vt., stated in a letter that he had made a valuable improvement in his wooden-tooth revolving rake; and he desired to have a committee designated to report on its merits. The committee will attend to it next summer, when there is hay to be raked.

Choice Seed Corn.

Mr. S. B. Fanning, of Jamesport, Long Island, presented to the club a sample of very fine field corn, called the Sanford corn, which attracted much attention. The ears were of large size, kernels large and cob small. It was admitted by the club to be a fine specimen, and, judging by its appearance, to be a superior variety. Mr. Fanning claims for it that it ripens early and in high latitudes, the extreme limit of corn growing, where tested the past season, has not failed in ripening. That it will yield more, with the same culture, than any other variety. He sent out a lot of seed last spring into different States for the purpose of testing it, and he stated that it has met with universal favor, and has yielded from eighty to 200 bushels of ears per acre. This variety was first obtained from Rhode Island, and crossed with Long Island corn, and it has been improved from year to year by a very careful selection of seed, in choosing ears of the earliest ripening, from stalks growing two or more ears, and with a strict regard to purity of seed.

Mr. W. S. Carpenter.—I am acquainted with this corn and can cheerfully recommend it. It differs from other sorts by being earlier, and in its productiveness. The seed has been picked for many years with special reference to early maturity, and two or more ears on a stalk. Side by side with the common sorts, as Yellow Flint, Kentucky Dent, &c., I believe it will yield a third or a half more. A great

many of the stalks will yield two ears. In some cases, the crops have been remarkable. It gives a sweet, fine meal, and tender, juicy stalks.

Apple Pomace.

Mr. H. S. Clement, of Winterport, Maine, writes: I noticed in your reports sometime ago a person inquired as to the utility of apple pomace as a manure for top-dressing and other purposes, and was told that it was not of any value after the cider was expressed.

Mr. Horace Greeley.—I don't see how the pomace of apples could be anything else than useful as a manure on orchards. It is an old and well settled principle that any crop in its decay becomes an appropriate manure for the land on which it was produced. Corn is a fertilizer for corn, cotton seed for cotton. I dave no doubt that damaged flour or wheat would be effective as a top-dressing on wheat fields; so the debris of apples should be a good top-dressing for the soil beneath apple trees. It may be necessary to get rid of the acid that would be developed when the pomace is passing the earlier stages of fermentation.

Dr. J. E. Snodgrass.—I recollect an instance where a garden was made on the site of an old cider-mill which I had bought, and, without having special care, it became remarkably productive.

Mr. P. T. Quinn.—In former years Newark was famed for its excellent cider. In making it large quantities of pomace were produced, and the farmers prized it as a fertilizer, but they made it into compost heaps with yard manure, and it was well rotted before it was applied.

Mr. W. S. Carpenter.—I have not found it necessary to resort to quick-lime, but mix the apple with green yard manure and let it remain six months.

Cutting Fodder.

Mr. Warren Gale, of Peekskill, N. Y.—I agree with Lucius Libby, in a former number of the club reports, that the practice of cutting hay and wetting and mixing it with meal in order "that horses may bolt it down with very little chewing and in a very little time" is, to say the least, of very little use, and quite likely to be attended with bad consequences. But I do not quite see the analogy between the "water and meal," in its effects on animals, as compared with hot coffee or tea on the human system. It scarcely needed the experiments and high authority of Thomas S. Lang, Esq., to prove that "it is more natural or better for animals to masticate their own

food, and that they will perform it more thoroughly and keep in better order than by any other system of feeding." Beyond question, the food is better "when mixed with saliva as nature designed," than when introduced to the stomach in any other way. I am familiar with all the different kinds of feed cutters used in the United States, and know very nearly the number of each kind sold, and know that nine-tenths of those sold in late years cut the feed from one and a half to two inches long. And this is not because those cutting so long are cheaper, as might be supposed, for there are those in market at low prices that cut very fine, but of course slower. Feed so cut (from one and a half to two inches) is effectually prevented from being swallowed without proper mastication. True it is eaten in less time than long feed, for the reason that the animal does not have to pull or bite it apart in order to introduce it to the mouth. Cornstalks, I know from experience, chopped up in this way will all be eaten with avidity, while, without being cut, much of it is wasted.

Now, as to the general advantage of cutting feed, nothing better can be said than the experience of the American farmer. It is not an old fogy notion of recent importation from England. Thousands of feed-cutters (I speak from positive knowledge) were sold yearly in the country twenty years ago, and ten times as many are sold now.

I know that the great difficulty with manufacturers is not to convert people to the value of cut feed, but to supply the machines for this purpose as fast as wanted, the call always being the largest where they have most experience in the use of cut feed. It may not always be profitable to cut first-class hay for young stock. One great advantage of the feed-cutter is to cut up and convert into palatable food, straw, corn stalks and other coarse fodder that would otherwise be wasted, to say nothing of the increase in quantity and improvement in quality of the manure heap.

Nearly all the railroads and large stable-keepers of New York city scarcely ever feed anything but cut hay mixed with meal.

They may not all be good chemists, or fully understand the process of digestion, but I doubt not experience has taught them their own interest better than to feed long, dry feed, or to cut it so short as to be "bolted down without proper mastication."

Mr. Greeley, has used feed-cutters for years, and it is fair to presume he finds a profit in it. No doubt many who have not had experience are prevented from cutting feed because they suppose that it must be cut very fine, and hence requires great labor, especially

by hand power, making it necessary to use horse power and expensive machinery. It may be news to some to know they can purchase machines in almost any agricultural implement store in New York, taking the choice of several kinds by different makers, from ten to fifteen dollars each, that will easily cut a bushel a minute by hand power, and some of the more modern ones will cut stalks as fast and easy as hay or straw.

Culture of Cranberries.

Mr. S. S. Ridgeway, of New Jersey.—"The value and productiveness of a cranberry bog cannot be known until the vines are from eight to ten years old. Jerseymen's opinions are generally absolutely worthless, the majority of them never having seen a bog of their own make yield two crops. The great requisites are, first, muck of the right quality and quantity; in Ocean and Burlington counties only cedar muck. In regard to muck, I make the following assertions: There is a great difference in muck as in soils. No other than cedar muck has ever succeeded in New Jersey. Some kinds of muck will yield as well as loam, and no better. It must not be less than one foot deep after the turf is removed. He who cannot select good muck cannot select a good cranberry site. Second, pure sand. Yellow sand is very often only colored by a protoxyd of iron, which bleaches, and is as good as the white. It must be at least five inches deep; it must be put on before draining. Third, thorough, complete drainage. Well, you must find new avenues to men's brains before you can reason with them on the absolute necessity of thorough drainage everywhere and for anything. Fourth, entire command of water, so as to flood during winter. Fifth, the right kind of vines. There are also minor considerations which affect the yield of a bog, such as exposure, the quality of water, irrigation, &c. In Ocean and Burlington counties three-fourths of the bogs will be total failures. In 1867, many bogs had just come into bearing, the season was unusually favorable, and they did very well. But it was their first and last harvest. Prosperity was too much for them. They will never yield again enough to pay for their care. Last year their owners complained of grasshoppers, worms, hot suns, &c., as an excuse for their failure. The good bogs did not fail. Good bogs never do fail, though the crops may vary. A good bog will average 150 to 200 bushels per acre yearly. They will net three dollars per bushel. Nothing in agriculture will excel for fruit or for the pleasure of

cultivating. A great deal of money is being absorbed in the cranberry business."

A Patent for New Varieties.

The discussion was opened by a note from Dr. S. J. Parker, of Ithaca.—I wish to interest the club in the matter of petitioning Congress for an amendment of the patent law, so that an originator of a fruit can have a patent on his fruit. In this I have a personal interest, in that I have some fifty new hybrids and crossed grapes that in two or three years I wish to introduce to the public; and as the matter now stands, he who sells a hundred or two grape vines loses all control over them before he is half paid for the cost of originating and introducing them.

Mr. Horace Greeley.—While I am willing to do anything in reason for the protection of originators, I do not see how Congress can pass a law giving them what they ask for without interfering with cardinal principles of ownership. If I buy a seed potato, what law can rightly stop me from selling some of the crop for seed to my neighbor. In order to be effective I must eat the potato or sell to a man who is likewise bound not to sell for seed. This, it seems to me, is going beyond the natural province of a law. So, as regards this Poughkeepsie grape. If the established laws of ownership will not protect Mr. Ferris, I do not see how a statute can be framed to give him entire relief. But I am by no means fixed in my opinion, and only ask that gentlemen will say precisely what they want, so that we can the better judge of the reasonableness of their demand.

Mr. A. S. Fuller.—The mischief from which we seek relief is this: Take the very grape that Mr. Greeley refers to. We are all convinced that one vine of the Walter in Messrs. Ferris and Caywood's yard has produced a very fine grape. Now, before these planters can know in how many different soils and climates the Walter does well they must send the vine to fifty men in a dozen or more States. By the time they are able to recommend it for all parts of the country, twenty growers have it for sale, and their profits are ended. We ask legislators to devise some relief from this injustice.

Mr. Horace Greeley.—If men steal, the laws give redress. If experiments are necessary to prove the excellence of a grape or a berry, cannot those experiments be made by men who will be honest and trustworthy? I am, as many know, a stickler for the rights of property, and for all the protection that a man's industry or his skill

and genius properly requires, but we must not in this step go against fixed rules and universal principles.

PLANTING THE LOCUST.

Mr. N. Hallock, Queens Co., L. I.—The owner (George Doughty) of the farm on which I now reside, many years ago became impressed with the value of the timber of the locust, and with great energy set about its culture for profit. He commenced in a small way by obtaining a few trees and setting them in favorable places, usually where wood had been cut off, where it was found they did the best; and, as they grew and threw up suckers, these were in turn set out. This process being slow, he searched the country for seed, which were planted in a nursery, carefully cared for, and, when large enough, they were in turn set in the woods.

The land mostly chosen to plant was the so-called worthless "Backbone of Long Island," which then could be bought for from fifteen to twenty-five dollars per acre, and was usually covered by a young growth of the natural timber, which was all cut off, and locust trees planted; and, after four or five years, there would be a thicket of dogwood, oak, etc. At the end of that time, the ax again went over and cut off everything. The locust, whose roots are great runners, being now firmly established, would send up an immense quantity of plants; so that, where originally set at twenty feet apart, they would now cover the ground sufficiently thick to form a forest of themselves. But the hardy dogwood was ready for an even start, and would strive for the lead; and it might have been a question which would get ahead, but the ever-vigilant hand of the master, ready to protect its favorites, would again be raised; and this time the locust only would be spared; and again in five years would it be cleared; after which, it would be left to care for itself.

Many a hard day's work can he tell of, that has come to naught. One lot of thirty-five acres, upon which had been set over 10,000 trees, which were all killed by drouth the first summer; but failure only strengthened his perseverance; and, the next spring, other 10,000 were set on the same ground; and this time the effort was crowned with success.

Now the net result of all this persistent effort is, that land which was bought twenty years ago for twenty dollars per acre had wood enough cut off to pay for the land; and to-day has locust enough on it to sell for $150 to $200 per acre, and leave the land in the best

condition for another growth. From one lot, planted thirty years ago, on land worth twenty-five dollars per acre, the timber was sold for $400 per acre; the purchaser doing all the work. Thus, the persistent efforts of one man have covered over 100 acres with locust, which, on land not worth twenty-five dollars per acre for agricultural purposes, is now worth from fifty dollars to $250 per acre; and, when locust is once planted, there is no danger of its running out, like the California "volunteer" crops, but it will increase with each renewal.

The uses of locust are very numerous, wherever lasting qualities and strength are required; it being the strongest wood grown at the north; its tensile strength being 20,500 pounds to the square inch, while best American white oak is only 11,000 pounds per inch (Haswell. Engineering), or but little over one-half. Our locust has more than double the strength of English white oak, which is 10,000 pounds per square inch. Its great strength makes it particularly desirable for treenails; so that there is not a wooden ship that sails out of New York harbor that is not fastened with locust treenails; and every A No. one ship has much of her upper timber of the same lasting wood. There is also a good demand for locust treenails for export; one firm sending many thousands each year to Russia, France, and England.

On the island, it is largely used for fencing, for which it is particularly valuable. Locust posts and good chestnut rails making a fence that will stand twenty-five or thirty years without further trouble. It also makes the best of wagon-hubs.

It is usually considered the most profitable to cut this timber at about eight or nine inches diameter, when it is sold for posts cut six and a half feet long, which will bring thirty cents to fifty cents per post, according to their size at the small end, by which diameter it is usually sold. Larger timber is more valuable, but it increases less rapidly after passing ten inches diameter, and large trees require more room.

My father was once offered fifty dollars for a tree that stood near his door, and had made its growth in thirty years. The tree still stands.

You will see by the above that the locust is a valuable, fast-growing tree. It flourishes on any dry soil, but an old forest is preferable for planting, and every rocky hillside can be turned to profitable use by planting with locust.

Why will not people wake up to the importance of cultivating our

forests? In Germany, government plants and cares for its forests as ours does for its children, and the time is coming when, if ours is not cared for, we will suffer for the need of it.

The conclusion arrived at by planting 100 acres of locust are these: The *tree* that is planted rarely succeeds well itself; but, after the roots are once established, cut to the ground the suckers thrown up from the thrifty tree.

Trees from the seed are less valuable than those grown from roots. There are two kinds of locust, white and yellow, the white being a great seeder; the yellow seldom seeding much, though I have seen them bear quite large crops occasionally; but this is the exception. Persons buying seed would be likely to get the seed most easily obtained and unreliable, as the white is comparatively worthless.

Last spring, a friend of mine owning land in Chautauqua county, N. Y., being desirous of planting locust, came here for seed; and we looked through the entire wood and found not one seed. But locust he must have; so, in the spring, I dug him a lot of trees, and having had some experience in propagating the blackberry from root-cuttings, I thought it would do equally well for locust; so I pulled up long roots, the size of my finger and less, which were cut up three or four inches long, and were planted in rows; and he tells me they grew equally well with the trees; and I think that little bits of roots, buried after the original wood is cut off, will prove an easy way to propagate this valuable, profitable, and quick-growing timber, and this idea will greatly simplify and lessen the expense of planting it in the far West, as thousands of the rootlets could be packed in a few cubic feet of box with a little moss, and be sent across the continent, to be planted on the slopes of the Rocky mountains, or the shores of the Great Salt Lake, or, in fact, anywhere where a good, quick-growing, lasting timber is required, which is as widespread as our great country.

Tribute to the Memory of the late R. G. Pardee.

The Chairman said, with deep emotion: When the club convened, I thought that on account of the unexpected death of one of our number, it would only be showing due respect to our departed friend and co-laborer, Richard G. Pardee, to adjourn for one week; for it is with feelings of sadness that we record his unexpected departure from this land of death. But, were he to speak to us from that glorious realm whither he has been translated, would he say, suspend your

duties to mourn for the departed dead? I am sure he would not. The Farmers' Club cannot say too much in his praise.

Mr. Pardee has met with us, when he has been in the city, for many years past. We all knew him to respect him and to love him. For a long period he has been engaged in the philanthropic work of establishing and building up Sunday schools all over the country, and his praises will be sung by thousands of Sabbath school children, and hundreds of Sabbath school teachers will mourn his loss. Mr. Pardee was always ready for every good word and work. He went about doing good. I have often heard his voice in the Sunday school and in the prayer meeting. He had asked and received wisdom of Him who giveth to all men liberally, and I believe, when he approached the river of death, his passage to the skies was serene and peaceful.

Dr. I. P. Trimble.—This sad intelligence is startling to me. I am grieved at the unexpected departure of our esteemed friend. I have been associated with Mr. Pardee for many years. He was exceedingly intelligent and agreeable in all the walks of life. In every commendable enterprise he was with us.

Dr. J. E. Snodgrass.—I desire to emphasize the suggestions of the chairman, by stating that up to the very hour of his death Mr. Pardee was announced to read a paper, which had been already prepared, on fruit growing. Our friend died with his harness on. He was a man of feeble health, and a hard worker. He fell a prey to that insidious disease, jaundice.

W. S. Carpenter.—We all feel the loss of our highly esteemed friend keenly, as he was one of the most active and always agreeable of companions. He was always pleasant, and always tried in every possible way to render those around him happy and cheerful, even by cultivating fruits and flowers. He was ever ready to add the influence of his example, and the benefit of his experience and talents to scientific discussions, as well as in many other capacities. He was known, respected and beloved all over our country. We lament his loss.

S. Edwards Todd.—Dr. Young, in his beautiful *Night Thoughts* of life, death and immortality, says:

> "The chamber where the good man meets his fate
> Is privileged above the common walks of virtuous life,
> Quite on the verge of Heaven."

It seems but yesterday since our departed friend, Pardee, met with

us, in this very room, to participate in our deliberations. As we took him by the hand it was plain to be seen that death had marked him for his victim. And it is befitting that strong men, who are rejoicing in the full glow of health, should pause for a moment amid the whirl of business and bustle of life, when a comrade falls, to glance at the past, to think seriously of the present, and to contemplate the realities of the future. Our departed friend was no idler. He did what he could to render the world wiser and mankind better. Work, for the night is coming, was his motto. Perhaps few men, who have done as much as he accomplished, made less mistakes than he. With the shield of faith in one hand, and the apostle's helmet of salvation, he fell at his post, like a valiant soldier, with his armor on, and his record is on high. Who will fill his place with more acceptance?

> "As we are now, so once was he;
> And, as he is, soon we must be."

He died as he lived, in hope of a glorious immortality beyond the grave, with unshaken confidence in Him who is the resurrection and the life of the people. A large circle of friends, beside the Farmers' Club, will ever cherish his memory and mourn his loss.

The excellent little books entitled *The Sunday School Worker* and the *Sabbath School Index* are from his pen; and the little treatise known as *Pardee's Manual for the Cultivation of the Strawberry, Blackberry, Raspberry, &c.*, of which he was the author, is one of the most useful books in our agricultural and horticultural literature.

The chairman then named P. T. Quinn, A. S. Fuller and Sereno Edwards Todd as a committee to report resolutions at the next meeting in regard to his death.

Adjourned.

February 16, 1869.

MR. NATHAN C. ELY in the chair; MR. JOHN W. CHAMBERS, Secretary.

THE CRAB APPLE.

Mr. D. F. Averill, Northfield, Vt., asks whether the so-called "transcendent" crab apple is as much superior to the others as its name would indicate.

Mr. A. S. Fuller.—The variety I consider the best kind in cultivation.

Mr. W. S. Carpenter.—There are, perhaps, a dozen new varieties of the crab apple. I have tested most of them, and have come to

the conclusion that for my soil and climate, twenty-five miles north of this city, in Westchester county, the Yellow Siberian is the best. I would say to our friend in Haverhill, by all means plant a dozen or more of the trees. They grow on poor soils; they do not draw upon the more valuable constituents of a soil, and they make a delicate and wholesome preserve.

Mr. William Lawton.—I have often been surprised that farmers care so little for this fruit. It costs but a trifle; it is hardy, and a large bearer. The crab apple yields fine cider, and, as Mr. Carpenter remarks, the preserves and jelly made from it are not easily surpassed. Fruits of this character are just as important in a full and various diet as potatoes or beans. The stomach requires a tart, and it is no answer to say that crab apples and cranberries contain no elements of direct nutrition.

Seed Corn.

Mr. S. B. Fanning, of Jamesport, Long Island, sent a box of his improved Sanford seed corn for distribution, and this note to the club:

"Gentlemen: As a number of the members at the last meeting expressed a desire to receive some of the corn which I presented at that time, I take the liberty to forward a box for general distribution, trusting that it may be fairly tested the coming season.

"As things were somewhat complicated at your last meeting, owing, I presume, to the great amount of matter brought up for discussion, I do not consider the corn was fully appreciated. Pardon me, therefore, for further introducing it to your notice. I claim that it is a greatly improved variety, first obtained from Rhode Island and crossed with Long Island corn. By a very careful selection of seed each year for ten years past, selecting the earliest ripening from stalks growing two or more perfect ears, I claim to have succeeded in obtaining a rarely superior variety of field corn. The demand for it and the high estimation in which it is held in this county induced me to send it out last spring into every State for trial. The very favorable reports received encouraged me to send it to the Farmers' Club.

"Experiments have demonstrated and analogy has shown that the finest and best samples of seed, continued for years, will improve the quality and quantity of the product. Better wheat is thus raised, and even a variety may be established. On this principle (in farm

stock) we have the short horns, blooded horses, &c. Most farmers plant and sow 'as it comes.' If an experience of twenty years as a practical farmer has taught me anything, it is that to sow and plant the best seed will pay the best, believing that 'like produces like.'"

Mr. Wm. S. Carpenter likes the corn so well that he had ordered his spring supply and should plant it for his main crop. The opinion of members was decidedly in its favor.

PREPARING SUMACH.

Mr. Wilson Barrett, of Keysville, Va., inquired what sort of sumach is valuable, and how to prepare it.

Mr. J. A. Whitney.—The leaves and small twigs of this same year's growth are cut in July or early August, dried on the ground, and gathered and ground for use.

Dr. J. V. C. Smith.—In Sicily the leaves are discarded but the twigs are used, and the bark also, both being ground, like medicine, in the apothecary shops of this city.

Mr. J. L. Aldrich, of Greenville, R. I., gave the following directions how to preserve and prepare sumach:

"Perhaps the New England method of preparing sumach for market may be of value to inquirers. The growth of stalk, which has formed since spring, is cut before the leaves have turned, and dried, with its adhering leaves, in the sun, care being taken to protect it from dews and rains, as getting wet turns it black and injures its value. When perfectly dry, it is cut into short pieces by a hay cutter, and is then ready for market. It is used in dyeing as well as tanning, and varies much in price, sometimes being as low as twenty dollars per ton, at others as high as forty or fifty."

APPLE CIONS.

Mr. J. C. Howe, of Lowville, Lewis county, N. Y., sent some cions of choice apple trees:

"Agreeable to my verbal promise to the club, made January 21, I have this day sent you a packet of cions for distribution, trial, and report to your club.

"You will please say to the members that the two varieties of apples of which I send cions, are both known to have originated with an amateur fruit culturist, who, many years ago, resided here, Dr. David Perry, and the cions herewith sent I have obtained direct from the trees in the doctor's old orchard.

"The fruit has been known with us for many years, and both varieties have an established reputation for superior excellence as table or eating apples.

"The 'Perry Red Streak' is a medium-sized apple, improving both in size and flavor by cultivation, of a flattened form, and smooth exterior, of a bright redish color, resulting from an abundant supply of vermilion stripes upon a brownish green. These red streaks strike through the flesh, which is a pure white, nearly to the seed case. The flesh is of a most delicious, spicy, sub-acid flavor; small seed, thin skinned, short stem, deep seated. The tree is a fair grower, spreading, hardly standing the rigors of our cold climate without suffering; is a profuse bearer; in fact, needs thinning for safety. The fruit ripens about the middle of November.

"The other cions are of a variety known among us as the Golden pippin, but to distinguish it from the apple known by that name among pomologists, I suggest the name of 'Davenport pippin,' out of compliment to the present proprietor of the old 'Perry orchard.' This apple is, if anything, superior to the first mentioned, being above medium size, of rich, light yellow color, thin and delicate skin, crisp flesh, mild sub-acid taste, and similar to the red streak."

Root Culture.

Mr. Wm. Day, Morristown, N. J.—In view of the growing wants of a great and growing people; in view of their ease of production and enormous yield; in view of the partial and, I trust, temporary deficit of the oat and potato crop; in view of so desirable a comfort and convenience to the wants of the table, the more extended and general cultivation of the root crop, as it is called, is a great national desideratum. Taking into consideration the vicissitudes and casualties of grain growing, coupled with the enormous price our eastern lands have reached, as Prof. Cook, of the geological survey, informs us, the average in New Jersey being, according to our last census, more than sixty dollars per acre, grain growing and grass farming must, in a measure, be remitted to the great prairies of the west. The time has undoubtedly come when progressive improvement is the necessary order of the day. Improved implements of culture must offset the continually increasing scarcity and consequent rise in value of good land, skilled labor, and fertilizers. Hence that the common farmer must switch off and come up in the right track, or the profit margin will grow beautifully less.

The faults of ordinary management are First: The impoverishment of the soil by continued over-cropping; second, the omission of a suitable preparation of the soil by reckless and indifferent plowing.

Such an apparent violation of well-known principles, nature abhors, and very soon asserts her better judgment, by withholding the desired increase. Begging your pardon, gentlemen, I only quote the words of another when I say "Nature knows better than man what the roots want." Root crops as they are called, delight in a kindly soil, and gentle and careful treatment. They bask in the sunshine of our most favored season; that season is but a short one. Hence every possible encouragement should be given. All garden-plants or edible vegetables should have a quick and strong growth to insure that succulent, tender sweetness so much prized. On most farms, after a fair preparation of soil, the crop is planted, in rows of course, but generally too close together for profitable working. The extra labor required comes at just the time when the farmers can illy afford it, and this I consider one of the most serious drawbacks to successful root-growing. This ambition to compete with the New York city market gardens is only a successful failure, as it involves too great a division of interests; a fact too often overlooked. Now what is the remedy for this defect? Give the crop reasonable space, enough to allow working by horse-power; not less than two feet, and for broad leaved roots even three feet will oftentimes be found practically advantageous. This question of agricultural labor is becoming a matter of no small importance, as out of it grow fifty per cent of the issues of life or death to farming. It is the farmer's mint where he coins his gains and his losses. The hired farm laborer gets say twenty-eight dollars per month, or, counting eleven months actual labor performed, $308 per annum. It would take but a meager calculation of figures to show that the ordinary farmer who depends upon his profits to make both ends met, must practice the most stringent economy. The crop planted, of all crops, demands, in the most arbitrary manner, timely care and attention; for irrevocable injury will certainly ensue if they become early enveloped in weeds. And with labor above high-water mark, and most thoroughly unskilled at that, he makes a virtue of necessity, procures a skeleton or narrow mold-board plow, "sinks it into the hub," cuts off the feeding-roots, and ruins his crop. The preparation of the soil I consider a matter of the highest importance. If we select a site unadapted to fruit, ever so much money, skill, time, and patience, only

grievously adds to the breadth and depth of certain failure, and forthwith fruit growing is decried as a doubtful investment. What incalculable advantages might have been reaped had this point been as deeply impressed upon our mind at the outset of life as years of sad and disastrous failure has fully demonstrated it. Never plant roots in ground ill prepared. Better wait till the "right time of the moon" goes down and comes up again, than plant in soil not properly prepared. It is a well known axiom also that soils acquire fertility by exposure to the influence of the atmosphere; hence, after a tedious and protracted spell of unfavorable weather, how often do we see the whole force of the farm summoned to subdue the army of weeds that are holding wild revel over the infant crop. Now one hour's efficient working of some labor saving implement would be as beneficial to him as days of delay would be disastrous, enabling him not only to save his crop, but putting it in his power to do just the right thing in just the right time. For the relative and comparative value of the root crop for both nourishing and fattening purposes, a few brevities, condensed from writers of authority, may suffice. One says all roots have "valuable nutritive qualities," some to a surpassing extent. Of the high value of the potato we need scarcely speak. Suffice it to say, two pounds of raw potatoes afford as much nourishment as one pound of good hay. Yet I believe better results invariably follow a judicious variation of food to man and beast as well as to land. Five pounds of carrots and six pounds of oats are considered equivalent to ten pounds of oats. The average cost of raising carrots in the old way may be reckoned at fifteen cents per bushel. One thousand eight hundred bushels of mangolds have been raised per acre at a cost of seven and a half cents per bushel, of which, according to experiment, 400 pounds were equivalent to 100 pounds of hay. Allowing sixty-six pounds to the bushel, the crop produced was equal in nutritive value to twelve tons of hay. To grow its equivalent in hay on an acre would of course be impossible. Take one more very familiar illustration: An ordinary crop of winter cabbage, planted three feet apart each way, and an acre will yield 4,785 heads, which, at the retail price, now selling at fifteen cents per head, would net $717.75; and even at ten cents per head would bring $478.50. I propose to show how this crop may be grown with scarcely one-tenth the labor usually bestowed upon it. As a necessary connection, therefore, to the important work of cultivating root crops, I suggest the use of a more efficient and

labor saving implement than any known to the trade. Every one knows how much better is the preparation of the garden by forking up and raking than by turning with plows and harrowing; and the implement desired now, in the place of the plow, is one that shall *fork*, *dig*, and *rake* at one operation; stirring the ground to sufficient depths, leaving it as nearly as possible in the condition of a garden bed prepared with a fork and rake. Such an implement I have invented, and propose to introduce. To this small model of it, I respectfully invite the attention of this club. The essential features aimed at in the strawberry or root culture, is to stir the soil without turning any furrow. Efficiency without complication is the golden rule for farm implements. The faults and vices of complication are prominent causes of many and repeated failures. Simplicity is usually economy, especially in agricultural implements. For obvious reasons farmers are not always mechanics, nor is the field a machine shop. The delay occasioned by breakage is a serious source of vexation and loss. On surfaces moderately smooth and clear of fast stones and of roots, the only description of soil where it would be sensible to grow roots, I claim new and remarkable excellencies in the working of root crops, strawberries, corn, cotton, tobacco, and hops, for "Day's Improved Cultivator and Horse Hoe." The small models exhibited were examined by various members of the club, and the principle on which they work was approved. When actual working models are built, a committee will be appointed to make full trial of Mr. Day's improvements.

How Prize Cheese is Made.

Mr. M. E. Meyers, Charlton, Saratoga county, N. Y.—Having taken three first premiums at the New York State fairs, on American cheese, and having been requested to impart my system of manufacture, I will now try and do so. In the first place we keep every vessel and everything connected with cheese-making scrupulously clean. I use one of Cooper's cheese vats, with Roe's heater combined. Young's curd knife, and a Herkimer county cheese-press. We are careful to have our milking done in a cleanly way. If necessary we wash the cow's bag with water, and wipe dry before milking, never allowing the milking to wet or moisten the cow's teats with milk. We strain the evening's milk through two thicknesses of cloth into the cheese vat, having previously filled the space between the two vats with cold water, and, if the weather is extremely warm, we

change the water during the night, generally before retiring to bed. The milk is stirred gently until reduced to sixty-five or seventy degrees, when it is left until morning, when the cream is skimmed off and mixed with the warm morning milk and stirred until melted, when it is passed through the strainer into the vat to be mixed with the evening's milk. A fire is made in the stove connected with the vat, so that by the time the milking is completed the heat of the milk in the vat will mark eighty-two to eighty-four degrees, the milk having been gently stirred most of the time after the fire was started, so as to have the evening's and morning's milk and cream well mixed. We add the rennet at eighty-two degrees in hot, and eighty-four degrees in cool weather, shutting off the heat at this point. The quantity of rennet depends on its strength; we wish to use only enough to bring the curd in from thirty to forty-five minutes. We do not color our curd; think that it injures the flavor, and is a practice that should be abolished; anotta, with which the curd is colored, being so often adulterated with red-lead. When the curd will break with a good clean fracture we cut it both ways with the curd knife, which will leave the curd standing in half-inch columns. The heat is now applied or started, and when the columns of curd will break clean over the finger, leaving no soft milky curd, we stir or lift the curd by passing both hands under it, very gently raising the bottom curd to the top, and so break and mix it up. We then let the curd rest for a few minutes, stirring it occasionally with the curd board until the curd hardens a little, and the heat has risen to ninety degrees, when we cut the curd, very gently at first, not so much so as the curd hardens; as the heat rises we cut the curd until it is about as fine or the size of wheat or barley. Of course we do not do this in a hurry, and we occasionally let the curd rest; it should be done with great care so as not to work out the cream; this cutting process will take from one to two hours. When the heat has risen to 100 degrees we shut it off, stirring the curd frequently, so that it will not settle on the bottom of the vat. We cook the curd until it looses its milky, glossy appearance, feels a little firm in the hand, the particles of curd looking a little contracted or shrunken, readily falling apart after pressing a handful together, and the whey, if all has been done right, will have a green shade. We now put the curd strainer in the vat and run off the whey; then stir and cool the curd before we apply the salt, breaking the lumps, if any, making it fine and lively, using two and a half pounds of Ashton salt for 100 pounds of curd; mix

it thoroughly, and do not put it to press until cool. Press the curd two or three hours, then take out the cheese, turn and bandage it, return it to the press, and let it remain until the next curd needs its place, having been in the press about twenty-four hours. The cheese, after being taken from the press, is weighed and put on the rack to cure; the next day it is greased with the oil of butter made from whey, colored with anotta, and kept at about seventy degrees, turned and rubbed with the oil daily for three months, when they are fit for market. I milk from thirty to forty cows.

Alsike Clover.

Mr. S. Edwards Todd read a brief paper on this clover, as follows; Alsike clover is known botanically as the *Trifolium hybridum*. Before the blossoms have appeared, the stalks and leaves resemble the common red clover (*Trifolium pratense*). But after the clover is in bloom, the heads are beautifully variegated in color from white to red; and instead of being large and nearly round like the heads of the red clover, they are small like the heads of the white clover (*Trifolium repens*). This kind of clover is no doubt a valuable acqusition to our country, as the reports of those who have raised it in numerous parts of the country speak highly in its favor. One remarkable peculiarity of the Alsike is, that there are from one to four seeds in each glume, while it is a rare occurrence that more than one seed is found in each glume of the red clover. As this fact has been disputed, I wrote to M. M. Baldridge, St. Charles, Ill., to forward some heads and seeds of the Alsike, which I have received and herewith distribute, together with a package of the clover seed, which resembles the seed of the red clover, except that the kernels are much smaller and many of them are of a darker color than the seeds of the *trifolium pratense*. For this reason a smaller quantity will suffice for seeding an acre. Four quarts, on rich land, will seed one acre satisfactorily.

The Alsike seed may be obtained of most dealers in garden seeds in our large cities. Mr. Baldridge writes touching this Alsike as follows:

"I herewith inclose you some sample heads of Alsike clover. You will find them somewhat mashed. I have just examined the pods of a single head and in several of them I find two seeds, and in three of them three seeds each! In some cases the glumes have four seeds. These sample heads came from a friend that had, in 1867, thirty-three bushels of clear Alsike seed on four and a quarter measured acres."

This friend writes as follows:

"There are generally two and sometimes three seeds in a glume. I inclose you some of my seed taken from the crop just thrashed. The seed of pure Alsike has many shades. Some are dark and light green, some brown, and some black. It is four or five years since I sowed the small field of four and a quarter acres. I have cut it twice for seed, and pastured it the balance of the time. It is my belief that it will last a good many years, without re-seeding, especially on moist ground. My crop in 1867, of four and a quarter acres, gave me thirty-three bushels and clean seed. Last season the dry land gave three bushels, and the moist six bushels the acre. The season was dry and unfavorable.

A Presentation to the Secretary of the Club.

Dr. J. E. Snodgrass, at this stage of the proceedings, came forward and presented a beautiful portfolio to Mr. John W. Chambers the Secretary, with the following appropriate remarks:

Mr. Secretary: At the close of recent proceedings connected with the presentation of a deserved tribute of respect and esteem to our worthy chairman, a member asked if we were "done with this mutual admiration business." He was answered, by another member, that he trusted we should never be done with it, and that "mutual admiration," and the harmonious feelings which it presupposes, would ever characterize our relations as coequal members of a club, to which he might have added the hope, which he no doubt had in his heart, that envy and jealousy, not to say malice and deceit, would be banished from the breasts of all concerned here, whether officers, representatives of the press, or private members.

Precisely this, Mr. Secretary, so far as I know, is your bearing as a notably silent, but not the less efficient officer of the Farmers' Club. (The silent forces of nature are ever the most powerful). Your record embraces a faithful, untiring, and at the same time cordial, service of no less than eight years. This has been rendered in the double capacity of secretary and clerk, to say nothing of your ever obliging services as librarian of the Institute.

In view of the record at which I have thus glanced, the committee of donors, whose chairman I have the honor to be, has no fear that any one will begrudge you the well deserved token of esteem which I am about to present to you, and which is most appropriate to your office, as the custodian of as many as 90,000 letters which have

passed through your busy and trustworthy hands in a single year. It is but a trifle in itself. But our motive will not fail to add value to it in your estimation. The wreath of oak branches, acorns, and leaves, embossed on the covers of this port-folio will serve to remind you, sir, of the rural associations connected with your important labors in behalf of those who have the blessed privilege of beholding with the eyes of prosperity, the grand originals which furnished the artists ideal, as they send their roots down deeper and deeper into the welcoming bosom of mother earth, while their limbs spread themselves to welcome the breeze and the sunshine of heaven. Those originals furnish shade and shelter to the toil-worn farmers of the land, to whose number you have so greatly aided this, their own club, to make annual additions through the agriculture, encouraging transactions, the record of which it is your duty and pleasure to preserve for publication.

I will, also, hand you this neatly framed calendar, got up by the same firm from which the port-folio was procured. May the diurnal reckonings upon the face of this calendar find you as healthful and as happy as you have been in your past life, at least, that portion thereof, I venture to say, which you have so usefully spent as secretary of our association, whose importance to the whole country is only to be measured by the indispensability of the particular class it seeks to benefit to society at large. Of course, I am understood as alluding to the great farming class, for whose increased enlightenment the American Institute, through this club, so gladly and hopefully sends forth the seeds of truth along with the thousands of packages of more material seeds yearly distributed so unsparingly, with your assistance as our disseminating agent.

The secretary in accepting the beautiful tribute which had been presented in the above flattering terms by Dr. Snodgrass, said that it was extremely gratifying to him to receive such a mark of respect from the members of the Farmers' Club, occupying, as he did, the position that had been so ably filled by his predecessor, Judge Meigs, he felt at times his inability to perform the important duties appertaining to the office. He thanked the donors for the present they had made, and should treasure it as long as he lived.

Feeding Corn—Cob Meal.

This subject was introduced by J. J. Tocheedy, Monroe, Wis., who writes: I have heard it stated by some experienced farmers that the

cobs ground in the feed will hurt the stomachs of the horses, although they will do no harm to ruminating cattle. Other farmers, having also long experience, say that the cobs will not harm any stomach, but give no nourishment, though they call it a useless trouble for the stomachs. May I venture to ask what is the opinion of the club? Will the cobs ground with the corn and fed to horses do any injury and cause sickness to horses, or be a simple, useless ingredient in the feed? I should be much obliged for an answer, and perhaps others might be interested. I believe in cut feed and mix it with this ground corn meal."

Mr. W. S. Carpenter.—I have a fact that will settle this question; A friend who keeps milch cows has practiced boiling cobs for his cows, and he gets from every half bushel of boiled cobs four quarts of milk. He is satisfied that it does pay to feed corn-cobs, if they are boiled before feeding.

Dr. Isaac P. Trimble.—There is no advantage in feeding corn-cobs to domestic animals.

Dr. J. V. C. Smith.—I must stand between my friends, and say that the only advantage to arise from feeding cob meal is attributable to the stimulus of the distension of the animal's stomach. The nutriment derived from cobs is very dearly bought. Beyond the stimulus which cobs afford of distending the stomach, there is nothing gained by feeding them.

Berry Baskets.

Mr. J. Gridley, Auburn, N. Y., exhibited a new style of berry basket, very ingeniously made of wood without a nail, pin or glue, which seemed to meet with much favor among fruit-growers, as fully equal to anything in use. Each basket is made of wood veneering about one-sixteenth of an inch in thickness, locked together at the ends by an ingeniously made mortice and tenons in the same piece of wood, bent in the form of a cheese hoop. The bottom is held in the desired place by the stub-end of short and strong slivers on each side of it, so that nothing but rough usage, sufficient to crush the basket, will displace the bottom. And these beautiful little white-oak baskets, nice enough for the president of the United States to eat mush and milk out of, can be made, it is stated, for only one-fourth of a cent each.

Mr. P. T. Quinn.—I admire this basket, only there is no provision made for ventilation.

Mr. A. S. Fuller.—I would like to call Mr. Quinn's attention to

the baskets in which fruit is brought from the south. You never see any provision made for ventilation in those baskets. Thousands of bushels of the choicest kind of fruit are brought to our market in tight baskets. The subject of ventilation has been over-estimated by fruit dealers. The great want has been *cheap* and strong baskets. And here we have it. When fruit-growers are required to pay from two to four cents for their pint or quart baskets, to be given away, the expense absorbs too much of the profits.

PROGRESSED AND LOST MANURES.

G. M. Stebbins, Portland, N. Y.—As I understand it, progressed manures is that which has been through the barn-yard, and the oftener it has been to the fields and back again the more progressed it is. Every plant is a laboratory forming combinations and recombinations which no chemist can follow or detect, and the result is progression. I suppose it would have been impossible to grow our present grains and fruits with pre-adamite fertilizers, and that progressed manures alone, would enable us to go on continually increasing the quality o our crops. Is there so great a danger of all our fertilizers being lost in the sea from the waste of large cities, as we are sometimes told? Is there more danger of this than that all the water will run away into the sea? Do not all come back together in the fertilizing showers?

HOW TO RAISE SAGE.

Mrs. Sarah Ann Browning, Watertown, Washington county, Ohio. —I see through the club report that there is an inquiry from a correspondent who wishes to know how to raise sage. Years ago I had some experience in this plant. I heartily give him my experience. Twenty-two years ago I set out three sage roots on a loose sandy soil, thirteen miles, from Little Rock, Ark. Every spring I took them up and split them as much as they could be split (which should never be omitted), and set them out again on the same ground as far as it would go, without plowing any of the ground, merely digging a hole with the spade in rows about two feet apart one way and eighteen inches the other; every year not putting in less than one pint of hogs' manure to the hill, which had been piled up in the fall and well rotted. Till the sixth year I manured with cow manure, prepared the same way. That was an uncommon wet year, and I picked, I have forgotten just how much, but less than half glutted the market. I picked not less than 115 pounds that year, perhaps more. I thought

there were fifty pounds wasted on account of sickness. That was my last year of raising sage; not because I did not find it profitable, for it was very profitable. I could earn one dollar and twenty-five cents a day by selling my sage for thirty-five cents per pound (as I did), and work eight hours a day in any ordinary season. After letting your sage leaves get their growth, pick by breaking off the little tender branches with the leaves on them. They should be picked while they are tender enough to rub up into powder when dry. By so doing you will have two or three, and sometimes four, new branches where you had one old one. Never allow your sage, if you can possibly help it, to start to seed, for if you do you will not get much sage. I have always heard it said that sage must be dried in the shade, but I was obliged to dry the most of mine in the sun. It looked very fair, and there were not any questions asked as to where it was dried. I did not perceive that it smelled or tasted any different from that dried in the shade. It must be stirred occasionally while drying.

Grapes on the Lake Shore.

Mr. G. M. Stebbins, Portland, N. Y.—In the report of the grape growers' convention, at Canandaigua, last fall, a strip of land, seven miles long by about two wide, between the villages of Westfield and Fredonia, was mentioned as being the "home of the genus of the vine." Jutting into Lake Erie, and protected on the land side by high hills, no better natural situation could be desired. About a dozen years ago, I first came in view of this spot, and looking down, could think of nothing but the "Happy Valley" of Rasselas. I determined to have a home here, part way down the hill from everyday view, but within an easy walk of the great magnificence for holidays. Then, every family had a few vines, and there were one or two small vineyards. Now, we see vineyards dotting the whole landscape. Some say there will be no market for so many grapes; some vines will have to be pulled out. Others say, people are just learning how to use them, and to prove this faith are planting more vines. They grow so finely, and with so little care, people can afford to grow them for the fun of it, if nothing more. Nothing makes so fine a jelly as the pulp of grapes, and the skins, preserved, have the flavor of raisins. Another excellent way the people have found out, is to pick the grapes from the stems, and place them in a stone jar, with a layer of sugar between each layer of grapes, keeping the whole covered with dry sugar. As the poets say, there are potent

influences impersoned in those purple clusters, and if the coming man does not drink wine, will find out some less objectionable form for this subtle sun-essence.

How to Manage Night-Soil.

A correspondent in Dayton, Ohio.—"I have an opportunity to get night-soil from the city. How can I manage to deodorize it and prepare it for handling at this season of the year, when dry earth cannot be had?"

Mr. J. B. Lyman.—Dry muck or peat is even better than dry garden mold. But in the absence of both he can handle it with little inconvenience, and at the same time add to its value by having several barrels of sawdust or fine shavings moistened with diluted sulphuric acid. Throw several shovels of this into the bottom of the cart, and scatter them in freely as the manure is thrown in. Then cover the top with a layer. Copperas water would serve as a substitute for the sulphuric acid and water, and plaster of Paris would prove a good deodorizer. So would quick-lime, but it would burn the strength out of the manure unless it was composted with muck.

Tribute to the late R. G. Pardee.

Mr. S. E. Todd, chairman of the committee to draft resolutions with reference to the late R. G. Pardee, offered the following preamble and resolutions:

The obsequies of our departed friend are over. He was taken to Greenwood, Long Island, like a shock of corn fully ripe, where his ashes shall lie in peace, until the trumpet of the archangel shall call him from the mansions of the grave. All that is left behind is the memory of his faith, his devotion, and his zealous labors of love; therefore,

Resolved, That the Farmers' Club, of which he was a respected member, record their unfeigned sorrow at his death, and their testimony of high respect and love which they have ever entertained for him as a faithful co-worker in the performance of life's arduous duties.

Resolved, That our condolence and heartfelt sympathies be extended to the surviving relatives, who mourn the loss of one whose years were devoted to usefulness in the Sunday school, in the church, and in the private walks of life.

Resolved, That these written expressions of our tender regard for the departed be signed by the chairman of the Farmers' Club; that

a copy be transmitted to the near relatives of the deceased; and that these resolutions be published in suitable form for their preservation.

Adjourned.

February 23, 1869.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

HOW MUCH IS A BARREL OF APPLES?

Mr. B. D. Flemming, of Mills Falls, West Virginia, asks this question. He would know, before shipping to New York, how much his barrel must contain to meet the requirements of this market.

Mr. W. S. Carpenter.—There is no rule about it, and different barrels may vary as much as half a bushel. Generally, in shipping to England, the barrel is full two and a quarter bushels, or scant two and a half; less than two and a quarter is noticeably small.

Mr. P. T. Quinn.—This answer is according to my experience in the market. But there should be a given rule on this subject, and vegetables ought to be sold by weight. There is gouging and dishonesty among all the small dealers in these articles, and the part of the community that suffers most is the poorer part, who can ill afford it.

WINTERING SWEET POTATOES.

Mr. B. W. Steere, Adrian, Mich.—Having for twenty years raised sweet potato plants for sale, preserving the potatoes till spring has become as much a matter of course as keeping apples or common potatoes. I use no sand, with its suffocating dust, or other packing material, the whole mystery being simply this: A register opens near the top of our living room into a ventilating flue, carried up with the chimney. This flue ends at the garret floor, and furnishes warm air to the sweet potato room in the garret. Here, as soon as dug, the potatoes are placed in barrels, which are covered with old oil cloth, leaving an opening for two or three weeks to pass off the damp; but when moisture ceases to collect on the under side of oil cloth, I close up tight. The heat in this room must vary from forty or fifty to eighty degrees. We occupy the room below daily, covering up the fire nights. We often have sweet potatoes for the table till the slips are ready to sell, thinking them all the sweeter for having lain in their warm nest so long. The whole secret seems to be, give them *heat*, and plenty of it; in short, don't let the fire go out.

Marketing of Perishable Fruits.

Mr. J. C. Derby, Aikin, South Carolina, read a paper on the best mode of taking delicate and tropical fruits to market. He suggests the use of a large refrigerator in which the temperature may, by the use of ice, be kept at forty degrees.

Mr. W. S. Carpenter.—This would not be low enough. To last any time the temperature around fruits should be thirty-two degrees. I have kept strawberries two months, and pears six, by preserving around them this low temperature.

Cahoon's Seed Sower.

Mr. Goodell.—This contrivance was brought upon the stand and its operation illustrated. It throws the grain a rod each way from the sower, and scatters it even. It sows all the grains, and costs ten dollars. Mr. Carpenter said he had used one ten years, and likes it.

Poultry Keeping.

Mr. Daniel E. Gavit, Secretary of the New York State Poultry Society, called the attention of the club to the exhibition, to take place on the 22d of March, at the Empire Rink, of domestic and fancy fowls. The chair spoke of the importance of the subject and the propriety of ascertaining from those who make poultry a business their mode of selecting, pairing, breeding, and rearing chickens. He appointed Messrs. Joseph B. Lyman, Andrew S. Fuller and William S. Carpenter, a committee to visit the exhibition, and report to the club whatever of general value may be learned there.

Mr. D. B. Bruen, Newark, N. J.—I am glad of this movement. Farmers can make as much profit in poultry as they can on beef or potatoes, and with much less hard work. I have kept hens for a great many years, and have made it pay as well as any branch of farming. I have had the Spanish and, afterward, the Leghorn breeds. I sought eggs mainly. My boxes are just a foot square, so two hens never quarrel for one nest. With fifty-eight hens and two roosters I produced in one season 667 dozen eggs. I fed with oats, cracked corn and cooked scraps. I am particular to keep them clean, giving them dry sand, ashes, and clean straw. They are very fond of oyster shells, burnt and pounded; and I think they make thicker and stronger shells when they have lime in abundance. In the season referred to, those fifty-eight hens cleared me eighty-three

dollars and thirty-two cents, besides their droppings, which I consider the most valuable of all domestic manures. I feed them just as I do myself, three times a day, and supply fresh, clean water daily. Some people wonder how I get time to do all this every day. I will tell you the secret: I get up before breakfast; I leave my bed when the chickens fly down from their roosts.

Mr. A. S. Fuller.—I have no trouble about eggs or chickens, and I let my poultry go where they please. There is a bin of wheat where they go and help themselves. They get all the buckwheat they want, and in the winter green food, such as chickweed, or, if that is covered, cabbage leaves chopped.

Mr. Daniel B. Bruen.—I give you my experience for one year in raising poultry. As I was but a novice (when I commenced the science of "henology" some few years since) as to their habits, proper food, and nature, I have been obliged to learn everything in relation to that subject by experience. I commenced the year with fifty hens and two roosters, black Spanish breed, with a cross of about one-eighteenth game and Leghorn. I commence my account January 1st:

4 weeks to January 28th	293	eggs.
4 weeks to February 25th	678	"
4 weeks to March 25th	971	"
4 weeks to April 22d	1,063	"
4 weeks to May 20th	955	"
4 weeks to June 17th	861	"
4 weeks to July 14th	720	"
4 weeks to August 11th	593	"
4 weeks to September 8th	541	"
4 weeks to October 6th	470	"
4 weeks to November 9th	294	"
4 weeks to December 1st	248	"
4 weeks to December 29th	306	"
2 days, 30th and 31st	20	"
Total	8,013	eggs.

From January 1st to December 31st, 667 dozen and nine-twelfths eggs. Eggs have averaged in our market over twenty-five cents per dozen.

667 dozen, $\frac{9}{12}$ at 25 cents	$166 94
My family have used thirty fowls, at 37½ cents	11 25
My stock now numbers seventy-three.	
Increase of stock, thirteen; 37½	4 88
	$183 07

I have kept an accurate account of the cost of food purchased; when I have fed them corn of my own raising, I have charged them one dollar per bushel; the whole cost of food has been...........................	$99 75
	$83 32
I had twenty bushels of hen manure (very clean), worth seventy-five cents per bushel.....................	15 00
Profits on fifty hens.............................	$98 32

I have fed my fowls almost exclusively on well cooked food, composed of two parts cracked corn and one part oats with the addition of about one pint of pork-cutter's scraps well broken up. I feed them regularly three times each day, except in the winter, twice, and sprinkle corn in the house for them through the day. I keep fresh, clean water for them constantly. I found there was a saving of forty to fifty per cent between cooked and raw food. I feed them on boards prepared for the purpose and always kept clean, which is a great saving of food. My boxes are one foot square, which in a great measure prevents a second fowl from getting in the same box with a sitting hen. I procure one barrel of oyster shells at a time, and roast them moderately (not to burn them) as many as will fill a box (one peck). I have an iron box, used by malleable-iron founders to anneal castings and with an iron pounder (made for the purpose), I pound up the roasted shells in the iron box, which my fowls always eat after feeding, and if deprived of them, when again supplied they devour ravenously. Cabbage leaves, salad, turnip tops and the refuse of most vegetables they eat with great avidity. My fowls have the range of one-half acre of ground, and the soil was taken from the surface in the house and filled in with red sand, which is perfectly dry, in the winter for them to wallow in.

Dr. J. V. C, Smith, in reply to these testimonies of practical and successful poulterers, brought up medical philosophy. He did not believe in having anything artificial about chickens; this cooking their food is contrary to the established rules of the faculty. Doctors know it is all false and unnatural. Beside it is something undignified for a rational, intellectual being like man, made in the image of his Creator, to be puttering over chicken dough and cooking the food of animals, when that Creator has made them with a mill and a stove in their own economy to do their own cooking.

Mr. D. B. Bruen.—Dignified or not, I find profit in it. Anything that a man does to make good food abundant and cheap is not undignified; in fact, it is in better taste to line the human stomach with fat chickens and fresh laid eggs than to wrench it with ipecac, and physic it with calomel. People often ask how eggs are kept from summer to winter. I have never had any trouble about it. There are two modes, and I have succeeded with both, either to pack them, little end down, in fine dry salt, or dip them in melted lard so as to coat them thoroughly. Salt gives less taste than lime or oats.

G. S. Shaeffer, Amherst, Lorain county, Ohio, asks of the club some instruction as to sap; the way to get the most from trees, the situation of trees that yield the most, and on which side to tap.

Mr. J. B. Lyman.—The sap season is from the time the spring sun begins to warm the trees to the depth of some inches, till the buds are considerably swollen. It begins sometimes in the latter part of February, and lasts till about the 10th of April, but varies greatly each year. The first sap that flows early in the season is the best, and gives the highest flavored sugar. The best sugar trees are those which grow where the roots are considerably protected by stones or by running deep in the ground; also those which have a wide spread of foliage. There is a good deal of difference in the richness of sap in different trees of the same grove, and in the same tree at different periods of the sugar season. Deep boring does no more good than a hole of three inches, for the flow of sap is mostly from the wood nearest the bark. It hurts a tree very little to tap it, for as soon as the sap is needed for growth the character of it changes, the wound becomes clotted, and the flow ceases. The sugar is what would make the starchy part of wood. It is, in solution, forty pounds of sap on an average holding one of sugar. At the opening of the season a tap on the south side yields much the most. But after the air becomes quite warm, and the heat is felt in the ground, the sap will flow from a cut on the north side as well. The distance from the ground of the incision is a matter of little importance.

COMSTOCK'S SPADER AND DIGGER.

Mr. C. Comstock, of Milwaukie, Wis., the inventor of the "Rotary Spader," was introduced by the chairman, and read the following paper:

"By the successful introduction of the thrashing machine, reaper, mower, and corn-planter, and, in short, broad-gauged implements for

accelerating, lightening and cheapening all other labor of the farm, a necessity has been created for a substitute for the plow, the principles or combinations of which may admit of a construction of width and depth limited only by the power convenient to apply and control by one person, something on the rotary principle, that shall be divested of the compressing action of the plow upon the subsoil, the injurious effects of which, together with the tramping of horses' feet in the furrow, has long been a subject of comment by many of the ablest agricultural writers of the age. In this age of improvement it is not meet that we should be compelled to walk from 825 to 1,100 miles, as is now and always has been done, to every hundred acres plowed with animal power, in furrows twelve or nine inches in width. Could anything but absolute necessity, or the notoriety of testing his pedestrian powers for gain, induce a man to undertake a journey of 200 or 275 miles once or twice a year on foot? And yet this is what every one is compelled to do that plows his twenty-five acres once or twice a year. The small field of five acres requires forty to sixty miles of travel, and some little exercise of muscle beside, in holding and guiding the plow. Some may enjoy this exercise, but we know of many that would more enjoy an easy spring seat without the labor of holding the plow, if the work can be as well done. If it can be better done, if it can be done on a large field with less stops of the team than required in plowing, and in a more thorough manner than with a spading fork in the hands of a man, and with ease and comfort to the operator, who would not be glad to see it done? An implement of this kind, somewhat rude in its construction and imperfect in some respects, the first one brought before the public, was exhibited in operation before a committee of this club in the summer of 1862, known as 'Comstock's Rotary Spader,' and elicited a very favorable report; and in the field, though not as one of the committee, was one then of your members, who had devoted much time and expended much money in endeavoring to perfect a machine that should work the soil on the principle of forking up and mixing, as preferable to the packing action of the plow and harrow. I allude to Professor Mapes, since passed away. It may be remembered by some present here to-day, how cordially he congratulated us on our success in producing the action that he had found by experience necessary, but which he had failed to get. The encouragement thus received from your committee, and other members present at the trial, as well as from other eminent agriculturists and mechanics in other parts of the

country, who comprehended its simple and efficient, combination, encouraged us to persevere, which has been done in the face of obstacles usually attending the perfection and introduction of all valuable improvements, sometimes losing ground and sometimes gaining, but in the field every season and tiring not, until a successful thing is brought forth; and we feel justified in saying 'the thing long wanted has at last come.' It is now called the Comstock and Glidden Spader, and is in successful operation in this country. And in Europe, one operated on the grounds of the Emperor, before a committee of the Paris Exposition, 1867, was awarded a silver medal as having no competitor to entitle it to higher award. It fills the bill as admitting of a construction for width and depth, limited only by the power convenient to apply and control either animal or steam."

KEEPING QUALITY IN CHEESE.

George Crehore, Sandoval, Marion county, Ill.—Having just read Mr. John M. Webb's address before the American Dairymen's Association at Utica, I am induced to write a few lines to the cheese makers through the Farmers' Club. After telling how he went through 10,000 boxes of New York State cheese in London, in the month of October, Mr. Webb says: "Much of it has been disposed of and given satisfaction." But his last advices are that several dairies which were held over, "have faded in color and become strong or rank in flavor." To sum up, he says: "The result of the closing season then, as regards quality, would seem to be, that during two or three months you have made a larger quantity of finer quality than you ever made before, but also *that the cheese lacks keeping qualities!*" "Your endeavors must be to make superfine cheese not only in one or two months but from the beginning to the end of the season, and so to make it that it will retain its good qualities for a reasonable length of time."

Now what I wish to show is, that American cheese has been made of a quality, equal, if not superior, to cotemporary English cheese; that this cheese was made at all times from May to the middle of September, and that it had excellent keeping qualities. If specimens of this cheese could be laid before you, these points could be determined at once; but as the dairy now under consideration has ceased to exist, what herein follows will necessarily be historical, setting forth facts, and leaving it for you to judge for yourselves how far principles which are eminently practical in dairying on a small scale, are applicable

on a large scale. My grandfather carried on dairying in Walpole, New-Hampshire, a great many years ago; grandmother of course making the cheese. This cheese found regular customers in Boston and vicinity. Finally my mother took grandmother's place as cheesemaker, making the same quality of cheese and supplying the same customers. The largest portion of this cheese went to one customer, and after awhile it became known that he furnished it to the Tremont House, at that time peerless among Boston hotels. About the year 1835 or 1836, an agent from the Tremont House came to Walpole and contracted directly with my mother, then a widow, for the cheese, paying fourteen cents per pound for new, and twenty cents per pound for old. Before this time I believe this cheese brought respectively, twelve and eighteen cents per pound. The cheese was delivered *only once a year.* This contract stood until 1852, at which time the Tremont House changed proprietors. Ordinary cheese, during this period, commanded but six to eight cents per pound. Was this cheese equal to cotemporary English cheese? I never compared the two kinds; but being present one time when the cheese was delivered, I recollect very distinctly of hearing Mr. Tucker, then proprietor of the Tremont House, say that he did not have enough of it; that he could sell "stacks" of it if he had it; that he had to let some of his guests take a cheese home with them, and thus it had gone to the principal cities of the United States, and a good number had gone to England. Why should English gentlemen trouble themselves to take cheese across the ocean if they could be better satisfied with their own country's make?

Did it have keeping qualities? Being marketed but once a year, when it left the cheese room for the packing boxes the new cheese ranged from two to six months old, and the old from fourteen to eighteen months old. Now consider that this one shipment was the yearly supply of the hotel, and you will see that some of the new would be fourteen to eighteen months old, and some of the old would be twenty-six to thirty months old when consumed. Since the old cheese brought six cents a pound more than the new, it could not have deteriorated, but rather must have improved by age. It was colored with annota and never faded. Both old and new were on our table at all seasons of the year, and my distant recollection is that it grew darker colored by age, so much that the old could be told from the new by its darker shade of color alone. This cheese had a pleasant, smart, but not a strong taste. Its excellence was

due not only to treatment before it reached the hoop, but largely to the curing it received after it left the hoop. It was placed in a *chamber* to cure. This chamber was by no means a cool one. It was close under the roof, sheeting nailed to rafters formed two sides. The only window was in the east end. A chimney ran up through the west end, at the base of which a fire was kept at least half the day on account of dairy work. In this chamber the new cheeses were kept from the time they left the press till they were either sent to market or to winter quarters in a cellar. Belts of cloth were placed around those inclined to spread too much, but no cloth was placed over the disc surfaces.

The room was kept totally dark except during the performance of a daily routine of work therein. About the middle of November the cheeses to be kept over were placed in a tight cupboard in a cellar, and there remained till the next May. They were then taken out, washed, placed in a dark room on a lower floor, and kept till the following November. During this period they were turned and buttered only once in a week or two.

Other things being all right, there are three important elements that enter into the keeping qualities of cheese; viz., salt, cream, and time to cure in, and one of which being omitted, the keeping qualities are lost. It strikes me that your September make of cheese, which Mr. Webb examined in London in October, must have been deficient in the last named element at least. But granting it to be cured, it seems to me that if salt had been in just the right proportion, the cheese would not have become strong; and if all the cream that was drawn from the cow with the milk, was still in the milk when the curd was set, I do not see how your cheese could fade. I am aware that a very mild, pleasant-tasted cheese, can be made of milk with one-half the cream taken off. Many people prefer such cheese, because it is not so smart as new milk cheese. But it must be salted sparingly to retain softness, and in making such cheese the tendency would be to salt too lightly. Now, box up and ship before it gets well cured through, and you will in a few weeks find it beginning to grow strong. On the other hand, if it be much over salted, it will become ruinously hard, though it would be likely to keep much longer.

Boys being the most numerous branch of our family, I had often to assist in all the departments of our dairying, and have officiated at the cheese tub in my mother's absence. Hence what is here said

is not only from observation but from experience in dairying on a small scale, where the cheese run from twenty to thirty pounds. Let it be understood that I do not pretend to write about making cheese on the factory system; but from analogy I cannot see why your May, June and July make, put up in fifty pound cheeses, should not keep at least a year and improve in quality, if made from sweet *fully new* milk, salted just right, neither too much nor too little, and kept till November on shelves where it can be thoroughly *cured*. Whether you will get enough more for such cheese to pay the extra cost of producing, is of course for you to determine.

The animal heat question was not very troublesome. Our night's milk was strained into a tub where it remained till morning, cooling only to the temperature of the surrounding atmosphere. A cistern, however, holding about forty gallons stood near by, into which a never failing spring discharged its water. The morning's milk was added without cooling.

Lime and Plaster.

Mr. J. D. Hicks, Altoona, Blair Co., Pa.—I have read your proceedings from time to time with a great deal of pleasure, and I hope profit, and I will be obliged to you for information on the following questions:

When is the best time of the year to spread lime, and on what kind of land is it most beneficial, and how many bushels would you advise to be used to the acre?

Is plaster any benefit to land by being merely sowed over it broadcast with the hand, and what is the real object of using plaster at all? I have seen a great many farmers sow it on their clover fields, and never could see that it done any good.

Mr. J. B. Lyman.—Lime dissolves best in cold water. It should be on the ground when the winter snows melt, and at the time of the spring rains. If spread in winter it interferes with other farm-work but little. Lime does the most good on moist, clayey lands. It is a substitute, to some extent, for draining; for its action on wet, spongy pastures that incline to moss is to make the surface lighter and more porous. It benefits most soils, but the action of lime on sands is less apparent. As clover is a lime-plant, it is applied with great profit to lands just before seeding down. It is doubtful whether more than fifty bushels to the acre is distinctly beneficial, though many farmers apply a hundred.

Plaster is as useful as lime, but it acts in a different way, and with less regularity. A top-dressing of plaster on clover in the spring, when it is three or four inches high, has, on thousands of farms, been found a great help. If it does not benefit the Blair county lands, there must be some peculiarity about them. But the use and profit of sowing plaster is a question that each farmer must settle for himself by trial.

Mr. Hicks also asks the following:

When is the proper time to prune apple trees, and is the scraping of the bark intended only to scrape off the rough that gathers on it, or are you to go deeper? We have some apple trees that are about twenty-four or twenty-five years old, and can get them to do no good for us. Would you recommend them to be cut down, or can they be made healthy and vigorous again? They are all situated on good limestone land, in a protected place, and the ground is covered with a good sod.

Can you give us a plan or remedy to make plum trees fruitful? For the past few years no plums of any account have been raised in this part of Pennsylvania. A black knot, or something like a knot forms on the tree, and spreads over it until the tree dies; sometimes the tree blossoms nicely, but before the plums ripen they all fall off; the knots are most generally found on the limbs of the tree. A few years back we had plums in abundance, and now we cannot get them at all. I hope you will continue on in your good work.

Mr. J. B. Lyman.—The best time to prune apple trees is in the latter part of the winter and in March. Old apple trees, on a tough pasture sod, that have been unproductive for years, and have a good many dead limbs on them, are good for stove wood. Yet a great many such orchards have been brought out and made productive by the following treatment: Saw off the dead limbs and *some* of the others, but not enough to shock the constitution of the tree. Do not put the saw to a vigorous branch that is over two inches through. Plow up the orchard; fertilize with yard manure, plaster and ashes. If the trees are too thick, cut away some of them. Let the hogs and all the poultry range freely through the orchard till the apples are nearly ripe. If a great many little apples drop in July, have them buried or eaten up by hogs. Early in the spring is the best time to get rid of the worm nests.

For black knot on plums we recommend a pretty bold use of the knife, cultivation of the surface, wood ashes, and in March, at the time of the last snow, scatter under each plum tree two quarts of

salt. But all this, *while it may make fine, thrifty trees*, will not drive off the curculio.

Adjourned.

March 2, 1869.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Growing Barley.

Mr. A. G. Percy, Newark, N. J.—As I think Mr. Carpenter's answer to Emmon Walton's inquiry about growing barley will be likely to mislead, I wish to state that there are two kinds of spring barley grown here, called two and four-rowed; the latter are ripening ten to twelve days earlier than the two-rowed and will be sure to be ripe and want cutting as soon as Mediterranean wheat, whereas the two-rowed will not be ripe until the wheat is secured.

There has been but little winter barley grown here; the maltmen do not like it; it is mostly used for making pearl barley, but the yield is much better than spring barley, when it does not winter-kill, and were I a Bucks county farmer I certainly would obtain a few bushels and sow it as an experiment. It would be more valuable for feeding than either of the other kinds, because it is from six to eight pounds heavier per bushel, measured.

Mr. Henry Ingraham, Rockland, Me., says he has sowed barley for fifty years; that he uses three bushels to the acre, and would not advise mixing it with oats. He finds it superior to either corn or oats for fattening. He mows it when not fully ripe, gathers it like grass, and feeds out the straw.

Taming the Buffalo.

Mr. Jessie Felt, Greensville, Mercer county, Pennsylvania.—I beg to introduce a subject in which I feel intensely interested, and hope you will not consider it unworthy of investigation. Can the American buffalo be domesticated here and made useful and profitable? I think it can, and in support of my opinion, I will give you some of my little experience. I have had a small stock of buffaloes on my farm for many years, but owing to my age and infirmity I was under the necessity of disposing of all of them, which consisted of full-blood, half and three-quarter-blood buffaloes.

"The buffalo is a noble animal. It is true that he is bold and determined, yet very social. It is his social disposition that causes

them to congregate in such immense numbers in the western country. The buffalo requires kind treatment. It takes a great deal of evidence to make him believe that you are his friend and not his enemy, but when he believes it he never backslides. My buffaloes were tamed; they would come at my call with the speed of the racehorse and feed out of my hand. The buffalo is capable of enduring the severest winter without shelter, but does better with. He is moreover a profitable animal. The cows weigh from six to eight hundred. I killed one cow, the quarters of which weighed 742 pounds. The beef is better than any other beef, and if it was as plenty as any other beef it would sell for more, owing to its superiority. The robes are valuable, and when tanned in bark are worth double than when tanned by the Indian process. The fur of the buffalo is very useful. It can be manufactured into cloth, mittens, socks, comforters, &c., and is finer and softer than the finest wool, and much warmer. The buffalo will feed on anything that other cattle will eat, and will put on flesh much quicker. They increase in number about as fast as cattle. I had one cow from which I raised seven calves in seven years.

"The object for writing is, that the subject may become agitated until some man who is sufficiently able, or some company or companies, will engage in the enterprise and try to perpetuate the existence of that noble animal. I have no doubt that if judiciously managed it will be attended with entire success."

Mr. Horace Greeley.—The first question that the letter suggests is, is this a new experiment? I remember seeing the buffaloes in quite large numbers among tame animals on the Campagna around Rome. I apprehend that the buffalo is a tame, domesticated animal in Europe, and has been. There must be thousands of buffaloes in Italy among domesticated animals. I recollect seeing them there eighteen years ago. I used to eat the meat on the plains. It is a very dry and tough meat. It tastes like half-boiled chips (laughter), and the buffalo calves, that ought to have been tender, had the same dry taste; it was not as tough as the full grown animal. I doubt if you can make the meat equal to the domesticated cattle. It does not produce the same juicy, tender, succulent qualities that our beef does.

Chairman.—A gentleman has been stopping with me who says that the meat of the buffalo on the plains of Mexico is more delicious than any beef he had ever tasted.

Mr. W. S. Carpenter.—Experiments are being made in my town

on a farm nearly adjoining mine. Mr. Halliday introduced the buffalo four years ago, and as a neighbor I should rather condemn the experiment. They have become very troublesome to the adjoining farmers. It requires a fence eight feet high to keep them in their own fields. There have been some crosses made, and, as remarked in that letter, is a decided improvement. It is really fine. I doubt if they are available for the farmer to work his land with, they are naturally too wild.

How to make Hot Beds.

Mr. P. T. Quinn.—Dig out the earth from a pit of the size proposed and eighteen inches deep. Fill with horse manure for six inches; this should be warm with ferment. Over this for six inches spread manure that is now hot with fermentation and add a layer of earth of an inch or more. Then a layer of heated horse manure, and on that six or eight inches of good rich garden mold. Fork this over two or three times. Fit the cold frame over it, the slope to the south Let it be a day or more till the earth becomes well warmed. Mark off the rows and put in the tomatoes, lettuce, peppers, egg plants. Cover at night, if it is cold, with straw matting. Open for three hours in a pleasant day for ventilation, but be careful not to let cold wind blow in. The temperature in a hot bed should not be lower than seventy-five degrees. If the plants are yellowish, they need more air. The object in putting in the manure so carefully in layers is to secure a regular and prolonged warmth.

Home Made Opium.

Mr. W. O. Wilson of Uxbridge, Vt., addressed the club on the advantage of raising our own poppies. He has been engaged in opium growing for five years, and has derived great profit from it. He says a farmer can raise from 300 to 400 pounds per acre, worth in the drug-stores from $1,500 to $3,500. In 1867 he planted three-eighths of an acre with poppies and made 147 pounds of opium, and sold it for nine dollars a pound. Another year from a space of ten paces by five, he took sixty-eight dollars worth. He gives the following rules to guide those who wish to go into the poppy business.

1. Plant in rows thirty inches apart, and drop the seed eight or ten or twelve inches apart, from three to six seeds in a hill; then do not cover more than an inch deep.

2. Then hoe them once before you weed them; the second time

hoe them—hoe them close as possible with a sharp-cornered hoe; then weed the third time; you will not want to weed the fourth time; dress over; you will need to watch a little for worms.

3. The next in order is to get ready to manufacture the crop into opium. Get your mill and press in good order, then get your vat to hold the pomace; have it lined with tin or brass; then your plates to dry the milk on; get your sifter to cleanse in, and your alcohol to prepare the milk to eat off the morphine from the pomace. This will help, in drying, to prevent souring and to give the odor of foreign opium.

4. When you commence cutting the plant, you will see there are some plants that are more forward than the others. Sort them out and cut them first, just before the buds begin to ripen; you must not let them ripen; the seeds want to be full grown; keep sorting every day, until you get through, so as to have them uniform. The main thing to get the matter right is to put half a pint of alcohol to every fifty pounds of the pomace; then let it be stirred well together before pressing; then set a half hour; then press it. The alcohol will cut the morphine from the plant; then the extract will be perfect and in order; then the odor will be like foreign opium.

5. You will keep the cheese in the press about one-half hour; press it dry; about as much time is enough to set. Then have in the side of the setter, two inches from the bottom up the side, put in the faucet so the green can settle below the faucet; then draw off and fill your plates one-half inch deep.

6. Prepare your rack and shelves, three feet from the floor, eight inches apart, one above another, as high as six feet; have the shelves four rows of plates wide; have them so you can get on both sides with your pail with dipper to pour in the plates, all set on the shelves ready.

7. You must have the dry house or room a tight, plastered room, so that the heat will escape only from one window; have that drop down about three or four inches, so that the steam can escape. We want no chopping or jarring about.

8. As to heat, we want the thermometer hung half way up the room to temper the heat; you want the heat kept up from 125 to 150 or 160, and have coarse, hard, dry wood; if heat gets down it will sour. The business pays well, so keep up heat night and day until you get through.

9. As soon as the opium is dry enough to scrape off the plates,

(don't dry it so hard you can't) put it into square forms, one pound in each piece. About three and one-half inches square will be the size of one pound of opium.

Mr. Wilson makes two kinds of opium, one by cutting gashes in the capsules, and gathering the milk or gum that exudes. Then he cuts the tops of the plants, saving some for seed, and grinds them in a mill, and dries away the juice on earthen plates. This gummy or bogus opium he mixes with the true at the rate of two ounces of milk opium to fourteen of the gum opium.

Dr. F. M. Hexamer said that the poppy can be cultivated either in hills or raised over the land. All over the southern part of Europe the poppy is raised broadcast. The way to manufacture opium can be found in any book on drugs; so he had his doubts as to the advisability of paying $400 for this method. It is a very important object. Opium is used in immense quantities in this country. It is in every drug store. Laudanum is made out of it, morphine comes from it, most of the syrups and soothing liniments contain it. I would advise farmers to procure seed from a seed store and try it themselves.

Dr. W. W. Sanger.—Every physician knows that this opium is a most dangerous thing to use. I use it and others use it, in nine cases out of ten, without letting the patients know. They very soon become accustomed to it, it pleases them; it is a very easy habit to acquire, but it is a desperate one to get over. The question is, will not the general raising of this drug tend to make more opium eaters among us? The habit of alcoholism is a desperate one, but it is a perfect heaven beside opium-eating. I, for one, would say that the dearer it is the better. I speak as a medical man, having resided ten years on Blackwell's Island.

Report on Marl.

Mr. James A. Whitney then submitted the following report on a sample of shell marl, a specimen of peat or muck, and one of a whitish clay, all from western Virginia.

The shell-marl was composed of shells broken and worn apparently by attrition and pressure, and mingled with a small proportion of dark colored grains of earthy matter. It was so hard as to require considerable labor in pulverizing, which reduced it to a dark-gray powder. Heated with hydro-chloric acid, it effervesced violently, and gave a small sediment containing trifling amounts of alumina,

silica, and some organic matter. These were evidently derived from washings from the surface soil above the shell deposits. When tested under the blow-pipe, and also with phosphate of soda in presence of ammoniacal salts, it showed an entire absence of magnesia. With the blow-pipe, it failed to give any indication of phosphoric acid, but by a careful application of the molybdate of ammonia test, and allowing the liquid to stand for several hours, a very slight precipitate, the phosphomolybdate of ammonia, was obtained. This is the most delicate known test for phosphoric acid, and the minuteness of the precipitate obtained shows that a trace, and only a trace, of phosphoric acid exists in the shell-marl of which we are speaking. It may be mentioned here that the blow-pipe test, above alluded to, failed to show the presence of any appreciable portion of alumina.

The Second Test.

After this qualitative treatment the material was subjected to a quantitative test for carbonate of lime, which it was of course evident, constituted its larger portion; and, inasmuch as the determination of the percentage of carbonate of lime in different substances is at once one of the most common of analytical operations in agricultural chemistry, the details of the process may not be without interest to some. A quantity of borax was first vitrified in a suitable vessel, which had been previously weighed. After this the borax was melted in a furnace, and the whole, after cooling, was weighed. The difference between the weight thus ascertained and that of the empty vessel, of course, showed the weight of the calcined borax. Meanwhile a quantity of the pulverized shell-marl had been dried over a water-bath until it seemed to lose in weight, and, after being cooled under a desiccator, was added to the borax in the dish. The quantity of the marl, in proportion to that of the borax, was about as one to four. After another weighing, to determine the total weight of the two substances, the whole apparatus was placed in a furnace, where it was suffered to remain until the hot mass became perfectly quiet. It was then removed and cooled and weighed again. The loss in weight while in the furnace showed the amount of carbonic acid expelled from the lime by the action of the heat. As carbonic acid always unites with lime in the proportion of twenty-two parts of the acid to twenty-eight parts of lime, a simple calculation shows the weight of the carbonate, which in the present instance amounted to ninety-three and seventy-eight one-hundredths per cent.

Value of this Marl.

The shell-marl, so-called, is, therefore, valuable only as a source of lime, and in the absence of other supplies of lime must be of great worth for this purpose. In order to render the material more soluble than in its shell condition, it should be calcined or reduced to the state of quick or air-slaked lime, and in this form may be used in the same manner as when derived from other sources for any agricultural or other purposes. The sample of muck was a soft, pliable substance, dried by exposure to the air, and having a brown color, as was shown by the prussiate of potash test, due to the presence of peroxyd of iron. Its composition was determined to be as follows: Water, twenty-one, and eighty-two one hundredths per cent; organic matter, eighteen and eighteen one hundredths per cent; inorganic matter, sixty-one per cent. The composition of the muck does not indicate any unusual value in the material, nor any other use for it than the common one of an absorbent for liquid manures, or a component of the compost heap, for which purpose it should be as thoroughly air-dried as possible.

Analysis of Clay Subsoil.

The clay, the subsoil so-called, said to underlie the whole area of the farm from which it came, was hard and compact, containing minute black specks of an apparently carbonaceous nature, and when pulverized gave a buff-colored powder. It gave not the slightest trace of calcareous matter, as it failed to effervesce with nitric acid. It also showed an entire absence both of potash and phosphoric acid, although carefully tested for both. It is simply a nearly pure silicate of alumina, and apparently belongs to that variety of clay which is commonly used in the manufacture of yellow earthenware, and is worth about three dollars a ton. This, however, can only be satisfactorily ascertained by burning it in a potter's kiln, which would require from twelve to fourteen days. All of which is respectfully submitted.

Proposed Patents for New Seedlings.

Mr. A. H. Moore, Berlin Heights, N. J., protested against any protection, by law, for seedling growers.

Mr. Quinn, of Newark, said that few horticulturists were willing to have a law passed for any special object like that. The American Pomological Society have passed a resolution to Congress, wishing

that body not to meddle with the bill the grape growing society of the Lake Shore have presented. It was degrading to the horticulturists, and more money would be spent in getting out patents than there was any necessity for.

Mr. Greeley was glad to hear that a bill was presented upon the subject, that they might know what it was they wanted.

Mr. A. S. Fuller said he was the father of it. About a year ago a gentleman connected with the press came to him and he (Mr. F.) said to him that there ought to be some head-quarters where they could file their plants. Upon this he and the other wrote a couple of articles, and hence the present agitation. The question about the patents was the whole thing. His idea was to have a horticultural garden so that they might have their fruits described therein and recorded. Often old fruits came up as new. He thought they ought to have a botanical garden at Washington. The matter then dropped, and the chairman read a letter describing a piece of Sea Island cotton which was grown near Galvaston, Texas. It was from Mr. Wm. J. Jones, Professor of Applied Chemistry.

Mr. Carpenter offered the following resolution:

Whereas, By the death of Professor Mapes a vacancy has occurred in the Professorship of Applied Chemistry in the American Institute, and the Farmers' Club has been deprived of the advantages of such a professor; and whereas James A. Whitney has shown a great interest in the agricultural department of the institute by skillful and valuable analyses; therefore

Resolved, That the Farmers' Club do earnestly recommend that the American Institute, at its next meeting, fill the aforesaid vacancy by the appointment of Mr. Whitney as the Professor of Applied Chemistry in the American Institute.

Carried unanimously.

Adjourned.

March 9, 1869.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

CRUDE POTASH AS A MANURE.

Mr. H. E. Smith, Charles county, Md.—The winter, he writes, has been so mild and open that they have not made any wood ashes worth mentioning, and in making up his compost heap he proposes to use potash.

Mr. James A. Whitney.— He will find crude potash an unmanageable substance unless he dissolves it in water. Then he should mix it with dry peat. Thus he will get a very lively, active manure for grass and tobacco, but less suited to grain. If he adds a little salt it will be improved as a drill manure for potatoes."

Which Grape is the Best?

Dr. E. Ware Sylvester, of Lyons, N. Y., read a paper on the Concord grape:

An effort has been in progress for years to discover among our native grapes, one which in healthfulness, hardiness and productiveness, should be adapted to the wants of the million. To this end the prize of $100 was, years ago, offered by Horace Greeley, and other prizes have since been awarded. You are well aware that the Greeley prize was given to the Concord. This brought out a torrent of abuse mainly from those interested in other vines, and even Dr. Greeley, with his usual kindly feelings, thought it best to apply a *Tribune* soothing plaster to the wounded head of Iona island. To the base insinuations which were made in the public prints, the members of the Greeley committee made no reply, and make none now; they were willing that time and experience, the great regulators in agricultural matters, should justify, as they were sure to do, the award of the committee. Dr. S. then proceeded to cite a large number of authorities, statements of farmers, nurserymen, vineyardists and vintners in all parts of the country, showing that the Concord grape is more successful and gives better satisfaction than any other. Some vineyards have given remarkable crops. Geo. Husman, of Missouri, speaks of fifteen tons from an acre, or enough grapes to yield, if pressed, 2,500 gallons of wine. This is clearly an exceptional case. The evidence is that, as a rule, the Concord yields from five to eight tons per acre.

Mr. Horace Greeley.—As the prize I offered has been directly alluded to by Dr. Sylvester, I may say that with the award of that committee I had nothing at all to do. When they came to their decision I paid over the $100. But the end I had in view was not attained by that investigation. I intended to stimulate the production of new and better vines, and hoped some grape would be brought out having the hardiness and adaptability to soils and climates of the Concord, good bearing qualities, and, what the Concord wants, high and delicate flavor. But the award was to the Concord, and I could

never see what that man, whoever he was, did to deserve his $100. The Concord was widely cultivated, and all my money did was to advertise a grape already known; thus improvement was not stimulated, but rather checked. I am a little discouraged by the result, and do not propose to offer another bank note for a plate of common grapes. To my taste, the Concord has no quality superior to the wild wood grape of my boyhood. I admit that it is hardy and prolific; but, after all, is it much of a fruit? I hope others will take up this matter, and at length bring out a grape hardy, productive, adaptive and high flavored.

Mr. P. T. Quinn.—As a member of that committee, a word of explanation may be in point. There were two committees. The first decided on the Iona, and Dr. Grant claimed the award as the originator of the Iona. But there was a protest, a delay, a change in the personnelle of the committee, and the feeling with those who made the final award was that a grape like the Iona, known only to a few amateurs, did not come up to the requirements of Mr. Greeley, and should not receive the money.

Mr. Horace Greeley.—What I complain of is the eagerness of the committee. I did not care if they waited five years, and thus gave grape culturists a chance to enter new varieties. How do we know but Caywood's grape, for instance, the Walter, is as hardy and well suited to different soils as the Concord? If the prize were now open the Walter might take it for ought I know.

Dr. E. Ware Sylvester.—Two years or more have elapsed since that award, and has any grape risen up that could contest the palm with the Concord? This last fall, did not Concord receive the silver cup at Cincinnati for being the best wine grape, and the best table grape?

Mr. A. S. Fuller.—While I agree with Mr. Greeley as to the qualities of the Concord, yet I must say that he never put out $100 that has done more good to the farmers of this country. It arrested attention everywhere, and people began to buy Concord vines who never bought before. It has been the means of planting a vine in 10,000, yes, 100,000 yards and gardens. Of course we are not to rest in the Concord; but it is so much better than no grape, besides it affords the best sort of a stepping-stone to something superior.

The special paper of the day was then read by Mr. Joseph B. Lyman on

NEW JERSEY GREEN SAND.

The belt in which this remarkable fertilizer is found is not wide. Draw upon the map a straight line from the first to the second American city. That line will, from the point where it touches the shore of Raritan bay, till it crosses the Delaware, run over or near a marl bed. The strip is somewhat wider on the New York than on the Philadelphia side of the State, but on an average the width of country in which green sand is found is ten miles. There are three beds or deposits of green sand, each different from the other, and of a different geological history. It is a weird and seemingly fabulous story, as obscurely spelled in sand hills and mud banks, in the margin lines of old oceans, in vast stretches of subterranean kingdoms of dimness and silence, once rife with vegetable and animal existence, now sunk in the perpetual stillness of a geological grave.

When and how the upheavals took place; whether the giant force was volcanic or celestial; how long the first depression was in progress; when the down motion ended, and the crust slowly swelled up again from its ocean bath; the interval between the first and the second plunge; and, above all, the effect of these changes on the vegetable and breathing life which had sprung into existence during the upheaval; all these are nuts for the hammer of the geologist, and themes for poets' visions. For us, as students of agricultural science, it is enough to know that by three dips of the mainland beneath tide-water line there have been made three banks or beds of green sand. These beds are all near the surface in all parts of the strip which I have indicated, so near that the streams which run east and southeast into the ocean, or west into the Delaware, cut these beds, and show green sand often for many miles along their banks. In studying these formations, I have found three modes of inquiry pertinent: First, in visiting a marl pit or digging, what results do ordinary observation yield us? We see that in many places near the creek a bank of gravel and loam from three to nine feet thick is removed when the marl bed is stripped. The upper layer is, in most cases, of the color of chocolate cake; this crust or strip is seldom over four feet thick, and is called copperas, or poisonous marl, or rotten stone. It has so much copperas in it that, spread on the surface of a field, it will kill vegetation. But this can be taken out by mixing it with quick-lime. Then comes the bed of true or pure marl. The spaders cut it with long, spoon-shaped spits. It is so firmly bedded that, carrying

the spade down into it, requires a vigorous and steady push, and reminds one of pressing a thin-bladed knife into a new-made cheese. It comes up in chunks or cakes, retaining, for some time, the shape of the spade that cut its way, foot by foot, into the deposit. But a few weeks exposure reduces the pile to a grayish green color, friable, crushing between the fingers, and showing a fine olive reen, sand-like substance. Rub a pinch of it for a short time in the palm, till warmth and friction have driven off most of the moisture, and you have a light green powder and a dark green collection of roundish grains, not sand, not clay, having no angular or fractured edges or points. These we call the gunpowder grains, and they are the peculiar thing in Jersey marl. Let us scrutinize them. First, after rubbing them dry, as I have described, lay them on smooth paper, and apply a clear glass that will make this sand, as it appears to the unassisted eye, look as large as onion seed, the largest of them not smaller than small peas. What do we see in such a field? It is no longer sand, but a group of rounded forms, not spherical, but with lobes or swellings, like those on an irregularly grown tomato; between these lobes are little furrows filled with a fine pale green powder. The grains are of a dark olive-green hue, and the crust that walls in these grains is quite firm. But press upon one of them with a pin head or the tip of a knife blade, and it breaks down with a brittle crash and falls into irregular fragments of a pale-green color. Put these fragments under a higher power, and the microscope gives us only negative testimony. The molecule of green sand crushed gives no regular form, no suggestion of a cube, or a prism, or a pyramid; no convolution or whorl, as though it might be the fragment of a minute shell; nothing of all this, but simply an irregular particle, which by slight pressure falls into smaller but still shapeless atoms. There is no hint or vistage of either a crystalline or an organic law under which it was formed.

Suppose now, having found out all that the eye alone or aided by lenses, can testify, we set up a nicer scrutiny, and call in the aid of alembics, retorts, and reagents. What will chemistry reveal? New Jersey marl, or green sand, has been analyzed many times in different laboratories of the country and in Europe, with results that closely correspond. All the analysts find potash, all find phosphoric acid, all find lime generally, as a carbonate, and abstracting these substances that have fertilizing value, the bulk of green sand is made up of clay, sand, and iron.

Mixed as such deposits must be with clay and sand in degrees that change with each locality, these constituents vary; but in many beds the admixture of the clay and sand among the gunpowder grains is very small, that is to say, it is possible for the Jersey farmer to get at from two to eight cents a bushel, a marl that is nothing else than a mass of these dark olive green gunpowder grains. Now omitting fractions, what does the farmer buy when he pays out money for this curious green earth? In a bushel weighing eighty pounds he gets of potash soda about five pounds, of phosphoric acid about three pounds. In 100 pounds seventy-five are clay, sand and iron, ten are substances of great value in agriculture, and fifteen are water and salts or acids of little value, as magnesia. In pure green sand the quantity of lime is small, often not much over a pound in a bushel. But green sand is often found mixed with crumbling sea-shells. This shell marl is rich carbonate of lime.

How to use Marl.

Suppose the farmer has a pile of this fertilizer in his yard, how is he to get the most benefit from it? Suppose there are 200 tons, an ample top-dressing for a ten acre lot. In that 200 tons there are 20,000 pounds of a valuable alkali, and 12,000 pounds of an acid still more precious. But they are both locked up in these little, roundish, olive-green granules, which, uncrushed or undissolved, will do vegetation no more good than so much mustard seed shot; for be it ever remembered, that roots and rootlets drink water, and water only. If you would convey the acids and alkalies of manure, or of a rich soil, into your crop, you can do it only by dissolving them in water. The more dissolved potash, soda lime, and phosphate of lime and silica you can get a plant to take up, the faster it will grow. The chief complaint against marl is that it is not a prompt fertilizer; it does not show as much the first year as it does the second, and on sandy soils its effects are quite tardy.

It is clear that we should do something to it to break down that granular structure and release the powder within, so that water can promptly dissolve it. The moisture and heat of the dung heap will do it. Sulphuric acid will do it. So will quick-lime; so would other acids, such as the malic acid in apple pomace, and the woody acids found in peat and swamp muck. Hence we recommend to farmers to compost their marl with moist and sour substances. But when green sand is spread on grass, there is a moist and sub-acid quality in

the surface that comes in the decay of old blades, and the tough mat of roots holds the little granules to the surface, where the elements can act on them. For this reason green sand is generally found to act most promptly on grass lands. When applied to sandy soils, where there is not much vegetable matter to act upon it, marl is partly lost by being mixed with the deep sand, where it finds nothing to dissolve it. By numerous inquiries among the observant farmers of middle Jersey, I have found that experience on this point proves the conclusions to which microscopical study had led me. It acts quickest on sod, especially a moist sod. In fertilizing sand, it is not used as the first application, for it would find no profitable company, but after such lands have been limed or dressed with muck, or had a lush growth of rye or clover turned under, green sand comes in as a very useful agent to heighten fertility.

There is one crop that is an exception to this general rule, and that is the potato. There is more profit in using marl on potatoes than on any other crop. I have sometimes been asked to explain this, and the answer is that the potato wants two or three things that other plants do not want, and which green sand furnishes. Green sand yields some magnesia, a little sulphuric acid, and plenty of oxyd of iron; all these, and especially the latter, are beneficial to the potato. So important is iron, that some months ago I remember a thoughtful farmer sent the club a long communication showing that iron would stop the rot. Certain it is that potatoes grown with green sand are smoother, fairer, and healthier than others, and the marl-using farmers have been very little troubled with the rot. May I not then earnestly recommend to all farmers living within 100 miles of the marl-beds to buy green sand enough to put some in the hill with those choice new varieties of the potato that have not as yet become diseased. For its potash, green sand is worth as much as leached ashes; the phosphoric acid makes it useful for grain and the protoxyd of iron gives it peculiar value as a preventive of rot in the potato.

On lands that are already rich marl will not prove so potent as some concentrated ammonial, that is, rank smelling stuff. For instance, a sagacious old farmer in Salem county told me that some believed twenty years ago, when they first began to cart marl, that it would enable them to get 100 bushels of shelled corn from an acre. "I told them," said he, "it would never get up higher than seventy-five, and it hasn't and it won't." But for lifting up worn land from producing a power of twenty-five bushels to a power of sixty and seventy

bushels of shelled corn per acre, its effects are marvelous. Before it began to be used all that part of Jersey was a forlorn and hopeless region. Ten acres of it would give a little rail pen half full of nubbins. Now there is many a farmer who thinks the season or the tillage has been bad if he does not pick 150 bushels of ears from each acre of his field. Land that then was worth fifteen dollars, twenty-five dollars, and, at the highest, thirty dollars, cannot now be had at $150 per acre. Marl has wrought the change. Farms that hardly carried ten hogs and six bullocks, now turn off forty fat hogs and fifty beeves.

A Conjecture.

What is marl? Chemistry can tell us what are its constituents. The farmer tells us what it does to his crops. The geologist tells us something of its tilluric history. But is it of animal or vegetable origin? Is it the detritus of rocks, and if so what rocks and how were they thus strangely worn? As a general rule the aptest food of plants is the refuse of the food of animals or the decay of the bodies of animals. Nature moves in a great and most admirable cycle. Substances vile and refused of man, the offscouring and the excreta are taken up by vegetable life, and, by the kindly and subtle alchemy of life forces in the earth, wrought over into blade and flower and ear.

I do not believe New Jersey green sand is an exception to this law of nature. These little globules are, in my opinion, the excrements of sea worms. The waters in which they lived and worked were warm and still. They were a low order of animals, as dull, perhaps, as earth-worms, and probably as blindly industrious. They worked like the coral insect. They have perished long ago, like the birds that made the guano beds; but here are their remains, a perpetual treasure of fertility for higher races.

The relation of these beds to the region in which they are located is worth our consideration. All the region on the southward to the sea coast and Delaware bay is defective in those elements which the marl can supply. By reason of its natural sandiness and the fires which for generations have swept through its pine forests, the earth has been robbed of potash and phosphate, and the whole face of the country, though almost within sound of the fire bells of two great cities, has been, till within half a score of years, a forest primeval. Now, railroads are piercing the pine and oak thickets in every direction, and long trains of cars, loaded by steam and drawn by steam,

are doing what the Creator abstained from doing, they are mixing the latent with the surface elements and creating a valuable soil.

This great enterprise of agricultural creation has just begun. Our children will live to see the steam car and the steam marl-shovel coöperating till all that tertiary plain shall bloom with the crimson of flowers and fruit, and rustle with the music of ripened grain.

Before closing this paper, will you bear with me a few moments, gentlemen, if we lift up our eyes from these details, and speak a few words of wider import. Deep are the secrets of human history; deeper far the inscrutable mysteries of geological lore. Palmyra was sunk in sand, Pompeii overwhelmed with ashes, the cities of the plain were deluged with fire; but in these cool, green banks of manure, that reach from bay to bay across a commonwealth, are records of a submergence far more ancient, involving not an island, nor a city, but all the broad margin of a far stretching continent. Why this long plunge beneath the brine? What life of plants, or beasts, or fishes was thus quenched? He knows who made the world. But musing on these titanic hieroglyphs of the rock and of the mud, can we not catch gleams of a celestial husbandry; of a foresight that had been vigilant for human weal ages before the fig-leaves lolled in the perfumed air of the first garden. Long lapses there were of carboniferous life, whose sole utility, so far as we know, was to garner up heat and force in continental coal vaults. Later epochs there were of swarming sea life and mud life; waters lashed with armies of sharks, vast banks of mussels, leagues and leagues of mud-worms and shell-fish. Then all this existence, the active and the sluggish alike, was entombed. Old nature, wiser and more cunning than Egyptian priests, sunk these mummied forms of her dead children beneath the ocean beds, and piled banks of sand over them, but not that they might remain ever more sequestered from human scrutiny, not to sleep in an unending night. These marl-pits are our granaries. Here are our treasure vaults. Hence may exhume, not trinkets, not a shining nugget, not a glancing stone, but elements that shall pile our corn-cribs, that may stall-feed our oxen, and deck our tables with the wheaten loaves.

These buried fertilizers are not confined to New Jersey. They are found beneath the tide counties of Maryland, Virginia and the Carolinas. In Charleston, the great beds of phosphate that more effectually than any civil change may revolutionize the tillage of exhausted plantations, are of like origin, and have a similar geological history.

Doubtless the Creator meant more than hits the sense when beneath the arch of the first rainbow he told the patriarch never again should the animated tribes perish by a general flood. That dispensation of earthquakes and floods was necessary. By it the Creator has made the earth one vast cellarage; in its immeasurable vaults are held in store all that humanity needs for coming ages. Here are the exhaustless sources of warmth and power. Here are the sunken floors of old oceans, with all their long cumulated remains of animal life and animal death. By these tokens the Great Planter has taught the race that tillage need never exhaust a surface. Thus hath He provided for methods sounder, wiser than those we practice in that magnificent agriculture by which the coming races are to be clothed and fed.

When and Where to Plow Deep.

Mr. J. F. Wolfinger, Milton, Penn.—The time for plowing our grounds for oats, corn and other crops is now near at hand; but whether we should plow deep or shallow is the question asked by many. Some lands are improved while others are made worse by deep plowing, and hence many farmers, after all that has been said upon this subject, both *pro* and *con*, are still in doubt as to whether they should plow their own grounds any deeper than they have been doing. And now, to remove, so far as I can, "the perplexing mist" that hangs around this "vexed question," I send you the following practical information derived from those who have tried deep plowing upon various soils:

About twenty years ago, the commissioner of our United States Patent Office was desirous of obtaining trustworthy information in regard to the subject of deep plowing and its effects upon our soils and crops; and to obtain that information he sent out, all over our land, a printed "Circular," containing, among other important agricultural questions, this one, to wit: "How deep do you plow your ground for corn, wheat, &c.?" The following are the best answers to the question received from farmers residing in seventeen of our different States. The agricultural reports here referred to are those of our United States Patent Office for the years named. So read with care now what our deep plowing farmers say in regard to deep plowing:

1. *Maine.*—G. W. Guptill, of York county, says: Farms that have been long cultivated are being exhausted of many mineral manures,

such as phosphates, alkalies, &c., essential to a fertile soil. These manures will have to be supplied, or else a sterile soil will be the result. It is well known to men of science that they can be measurably supplied from the soil itself by deeper tillage with the *subsoil* plow. I was induced to make trial of it, and I would no more think of dispensing with its use than I would with the surface plow. (*Ag. Rep.* 1851, *p*, 141.)

2. *Vermont.*—H. W. Lester, of Rutland county, says: Many now plow deep and give thorough culture, and begin to understand that the greatest support on which they can depend is their manure. Men who make and apply much manure to their soils plow deeper and deeper, and give thorough culture, are generally rewarded by their crops, by the increase of the value of their lands, and by the additional means to make the soil still richer, while those who adopt the shallow plowing, half cultivating and half or less manuring, slovenly skimming operation are growing poorer, their crops and the value of their lands decreasing, and they are ready to say it is hard times, a hard life, and poor business to farm it, when at least they are merely apologies for husbandmen. (*Ag. Rep.* 1852, *p.* 134.)

3. *Massachusetts.*—Morrill Allen, of Plymouth county, says: The improvements consist chiefly in the more judicious application of manure and more effective tillage. The surface soil only is now moved among the Indian corn plants, deep plowing avoided as injurious. (*Ag. Rep.* 1848, *p.* 359.) Leonard Stone, of Middlesex county, says: In cultivating my land my practice is to plow as deep as the ground will admit, gradually increasing the depth until my largest grass plow will seldom reach the subsoil. Except when rocks prevent it I consider deep plowing of the utmost importance, and almost any lands that are under cultivation, except rocky and clay, may be deepened by gradually turning small portions of the subsoil to the surface to be converted by the sun, air, and frost to productive loam. (*Ag. Rep.* 1848, *p.* 363–4.) William Bacon, of Berkshire county, says: Deeper plowing, bringing up soil to the influence of the sun and air, which has long been excluded from them, is gaining ground, and better harvests tell the story of its virtue. (*Ag. Rep.* 1849, *p.* 90.) In a later report he says: The importance of deep plowing is now better understood than formerly, and farmers are practicing accordingly. (*Ag. Rep*, 1850, *p.* 307.) And still later he says: Deep and thorough tillage are among the best preventives of loss from lack of rain. The deeper the soil and the finer it is pul-

verized the more readily and efficiently it will imbibe moisture from the earth beneath and from the atmosphere, which is often buried when the clouds give no rain. Equal benefits result from lands so tilled in times of heavy rains. It is a known fact that deep soils soonest relieve themselves of superfluous moisture, hence we may conclude that they are best for preserving a uniform degreé of humidity. Can it be wondered then that the advantages of deep plowing or of subsoiling are yearly gaining more favor wherever their benefits have been tested? (*Ag. Rep.* 1852, *p.* 152.)

4. *New York.*—Charles Lee, of Yates county, says: Deeper plowing and more thorough tillage are gradually on the advance in western New York, taking it as a district. (*Ag. Rep.* 1849, *p.* 104.) David McVean, of Monroe county, says: When the oak openings were first broken up, it was not found advisable to plow very deep, or not more so than was necessary to get under the roots of grass and brush, which was about four inches. But, as the land became exhausted at the surface from continued cultivation, it has been found necessary to deepen the furrow gradually to seven or eight inches, and even to ten inches. And as the lime and salts become exhausted on the surface, a supply is sought in the subsoil for the wants of the crops. (*Ag. Rep.* 1850, *p.* 470.)

5. *Pennsylvania.*—William G. Waring, of Centre county, says: Our most successful farmers now plow from six to eight inches deep; but many are discouraged from deep plowing both by the heavy texture of that soil and the bad results which usually follow from bringing up a thick layer of clay at once. The subsoil plow has scarcely been introduced. It would seem useful in breaking up the subsoil and preparing it for the surface. If brought to the surface raw and fresh it bakes, and, becoming impervious to air, the plants growing in it perish. (*Ag. Rep.* 1851, *p.* 241.) Dr. Joseph Henderson, of Mifflin county, says: A clover sod is turned down for wheat in April or May, with a three-horse plow, as deep as it can be well laid over. (*Ag. Rep.* 1851, *p.* 245.) David Mumma, of Dauphin county, says: All good farmers prefer plowing as deep as they can without turning up the subsoil. The average depth is about eight inches. (*Ag. Rep.* 1851, *p.* 254.)

6. *Ohio.*—Benjamin Summers, of Erie county, says: Deep plowing is found beneficial, as the subsoil is generally composed of all the materials for promoting the growth of vegetation, and only needs exposing to the action of the elements to fit it for that purpose.

(*Ag. Rep.*, 1850, *p.* 371.) And in a later report he says: Very deep plowing and subsoiling have not been practiced to much extent, though, when done, the results I believe have been satisfactory. (*Ag. Rep.* 1852, *p.* 246.) James L. Cox, of Muskingum county, says: Many farmers are using the subsoil plow, and nowhere do they tell better than in our clay wheat land hills. First, they stir the ground deep, that in a heavy rain it may be prepared to retain the water, and thus prevent its washing the soil, or forming gullies. (*Ag. Rep.* 1851, *p.* 400.)

7. *Indiana.*—Isaac Kinley, of Henry county, says: Deep plowing is becoming much more common, the effect of which is abundantly evident in the increase of crops. (*Ag. Rep.* 1851, *p.* 429.) W. W. Bunnell, of Wayne county, says: Some experiments this season in deep plowing more than double repay the labor, both for corn and wheat. As attention is paid to better modes of preparing the ground, the crop is increasing. (*Ag. Rep.* 1851, *p.* 430.) S. S. Boyd, of the same county, says: Our corn ground is not generally plowed more than six inches deep, but I am satisfied that deeper plowing would well pay for the extra labor from some experiments which have been made in the vicinity. (*Ag. Rep.* 1852, *p.* 309.)

8. *Illinois.*—Samuel Colcord, of Bond county, says: There are farmers who have planted corn on the same ground ever since they commenced farming, say for twenty-five years, without changing their seed or plowing deeper than at first, still there are some who are bold enough to differ from them, and who, after their grounds have become a little worn, venture to let their plow in to the depth of from six to ten inches, and thus, without manure, obtain double the crop of their old-fashioned neighbors. (*Ag. Rep.* 1850, *p.* 198.)

9. *Michigan.*—W. T. Howell, of Hillsdale county, says: When the land becomes impoverished by a succession of crops, bad husbandry, or any cause, this simple method of plowing deeper or subsoil plowing is all that is necessary to restore it, and this only when the farmer neglects rotation of crops, clover and plaster, or refuses to return to the land, in manure, the crops which he has taken from it. (*Ag. Rep.* 1847, *p.* 404). Chester Hunt, of the same county, says: Instead of plowing six or seven inches deep, as we were wont to do, while our farms were new, many are setting the plow ten inches deep, and, by bringing the latent properties of the subsoil into action, our crops are increased. (*Ag. Rep.* 1852, *p.* 275.) Linus Cone, of Oakland county, says: Fourteen years since I commenced an entirely

new system of putting in wheat by plowing twice the usual depth, say ten or twelve inches, and manuring with green crop (clover) where the soil was exhausted. I increased the seed to two bushels per acre, and by thorough draining and top-dressing with plaster in the spring, I doubled the yield per acre, and rendered the crop sure. The highest average since then has been forty-three bushels, and the lowest twenty-three and a half bushels to the acre, making a general average for the whole of over thirty bushels. (*Ag. Rep.* 1849, *p.* 204.)

10. *New Jersey.*—James Campbell, of Somerset county, says: In the same field I had some fifteen acres of corn; which corn-ground was plowed and subsoiled twenty-two inches deep four years ago, and two lands left which were not subsoiled, but in all other repects treated precisely alike, and the land was all as nearly alike as possible as to quality; and we had no rains the past summer to wet the ground, plow deep until the 25th of August; but the subsoiled land stood the drouth so that the corn scarcely twisted, while the portion which was *not* subsoiled was nearly all dried up. My land is a sandy loam. (*Ag. Rep.* 1852, *p.* 169.)

11. *Maryland.*—F. C. Clapper, of Montgomery county, says: In turning under each successive crop of clover the depth of the furrows was increased an inch or two; thus when two crops have been turned under, the average has reached eight inches, and in some of the valleys has extended to ten and twelve inches. How much deeper it may be found advantageous to plow remains to be proved, but I believe that when clover and other fertilizing substances are turned under, just as deep as is plowed, so deep will be the soil, and no deeper; and, therefore, the greater the depth the greater the fertility, and the greater the probability of an increased crop.

12. *Virginia.*—Anderson Wade, of Henry county, says: In relation to plowing, by far the most important work on the farm, I will observe that every year's experience has convinced me more and more of the great advantage of plowing *deep.* While I would by no means depreciate the utility of the various manures or other means of fertilizing the soil, yet for this purpose alone "deep plowing" is invaluable. Not only by this means are larger quantities of the soil exposed to the fertilizing action of the atmosphere, rains, dews, or frost, but by imbibing the rains that fall, the soil that is plowed deep retains not only what it already possesses but whatever it may gain through the decomposition of vegetables, &c. It is well known to those who have tried it that, if the soil be well broken to the depth

of fifteen or twenty inches, with a large turning-plow and subsoil plow, none but the most hasty rains, if any at all, will run or wash away the soil. Within the last winter I have seen on my own farm this fact fully illustrated. A rain, unparalleled in this country, by which the water courses were raised higher than they had been known for many years, fell on a piece of land that had been recently plowed to the depth of twelve or fourteen inches, yet not a drop escaped; and consequently no part of the soil was borne off.

13. *Kentucky.*—Micajah Burnett, of Mercer county, says: The ground is prepared for planting corn by breaking it up in early spring with two strong horses as deep as the plow can be made to penetrate; and deep and close plowing in the breaking-up of the ground for wheat is also very important. (*Ag. Rep.* 1853, *pp.* 107 *and* 131.)

14. *North Carolina.*—G. S. Sullivan, of Lincoln county, says: By breaking up his land with a good subsoil plow, from ten to fifteen inches deep, it would absorb all the rain and stand the drouth much better. (*Ag. Rep.* 1851, *p.* 315.)

15. *South Carolina.*—Wilmot S. Gibbs, of Chester district, says: I believe I am the only man in this neighborhood who uses the subsoil plow, and I have been doing so for many years with great benefit. (*Ag. Rep.* 1850, *p.* 232.)

16. *Mississippi.*—Ebenr. Ford, of Marion county, says.: In regard to subsoil plowing in the cultivation of cotton, so far as my experience extends and from observation, I am satisfied that subsoil plowing will prove beneficial only in strong clay and prairie lands; and upon light and sandy soils will prove injurious. (*Ag. Rep.* 1850, *p.* 257.)

17. *Alabama.*—James H. Foreman, of Chambers county, says: Deep culture for the production of cotton will only do where the soil is rich, and abundant in alkali, else the little fertilizing matter will be so diffused through the broken subsoil that the cotton roots will not be able to collect it. Hence we see deep culture without manure produce large stalks with late and imperfectly matured seed, while shallow culture produces small stalks with better and earlier developed seed, owing probably to the greater concentration of the alkaline matter of the soil and consequent readier collection and absorption by the roots. We are, therefore, impelled to the conclusion that, however necessary subsoiling may be, it will be advisable on thin soils to attain it gradually, say an inch or two in a season, until the desired depth is reached. (*Ag. Rep.* 1852, *p.* 76.)

MAXIMS IN PLOWING.

Now, from these carefully tried experiments of our most successful farmers, we may draw the following twelve conclusions, and set them down as settled truths and facts, to wit:

1. That shallow plowing ranges from three to five inches deep, and common or medium depth plowing from six to eight inches, and deep plowing from nine to fifteen inches deep, or more.

2. That new grounds are generally plowed shallow at first, and gradually deeper as the surface soil becomes poor, until a medium depth of plowing is attained. New grounds that are full of roots or hard earth must of necessity be plowed up shallow at first, and gradually deepened afterward as the surface soil becomes poorer. But so long as shallow plowing will, upon any soils, produce abundant crops of good grain, grass, and the like, it would be unwise for us to plow them any deeper, for two reasons; first, because such deeper plowing would impose upon us an unnecessary amount of labor; and secondly, because it would cause the fertilizing elements in our soil to be used up or wasted much faster than is profitable or necessary.

3. That the best or most profitable depths of plowing will on every man's farm depend upon the nature of his soil and subsoil, and his supply of suitable manures.

4. That deep plowing will, even without manure, be profitable on all such soils and subsoils as are loamy and mellow, and contain by nature either a large or a moderate supply of fertilizing elements lying below our common depth of plowing. But that profitableness will, in case the supply of fertilizing elements be but moderate, be much increased by an application of suitable manures.

5. That when the remains of the lime and other manures, put upon the soil in previous years, have sunk down into the subsoil, or near it, and rest there, it will be profitable to plow deep enough to bring those remains of former manures up where the roots of growing plants can feed on them.

6. That deep plowing will be unprofitable, and at times very injurious when it brings up to the surface a cold, tough, and barren subsoil; and that when such subsoils are plowed up to the surface it ought to be done cautiously, and only to a depth of one or two inches at a time, and then be immediately and liberally manured with such manures as will correct the coldness of such subsoil earth, and make it rich and mellow.

7. That a stiff clay subsoil thus plowed up and manured and thoroughly cultivated will soon become a productive, loamy soil.

8. That as a general thing the deeper we plow the ground the greater the necessity for manures to increase the average yield of our crops and the strength and value of our land.

9. That deeply plowed lands are afterward not only more easily worked but can also be worked earlier in the spring and later in autumn than they were or could be before such deep plowing.

10. That the richest and warmest parts of our soil should always be kept at or near the surface of the ground, to enable our sown or planted seeds to germinate quickly and grow the most vigorously.

11. That deeply plowed and thoroughly tilled soil will be of a loose and spongy nature, and so, like a sponge, absorb and retain a large amount of rain, melting snow or moisture, and so be much better fitted than it otherwise would or could be to rise up and supply, by what is called *capillary attraction*, the roots of growing plants with sufficient moisture to make them grow on luxuriantly and profitably in times of great summer drouth.

12. That deeply plowed and thoroughly tilled soils will, at the same time, through their greatly increased mellowness and porosity, enable the superfluous rain or moisture around the roots of growing plants to sink down into the ground sufficiently quick and deep to do no harm to the growing crops.

It seems to me that these twelve conclusions, the results of actual practice, cover the whole subject of deep plowing, wherever we can plow deep, and that we are safe in regarding them as *maxims in plowing*, rules that we can always depend on and practice with perfect safety and profit.

COTTON, COTTON SEED, AND GUANO.

Dr. Lewis Feuchtwanger, just returned from an extended tour through the cotton States, reports great activity among the planters, and the liveliest inquiry for guano and other stimulating manures. One gentleman, whom he met on the road between Montgomery and Mobile, told him a piquant story about the yield of cotton in Hancock county, Ala., from the use of guano. All southern crops will be pitched heavy. He thinks Louisiana will yield her old ante-bellic crop of sugar.

Mr. Horace Greeley.—A planter who throws away his cotton seed, or sells it for oil, and buys guano, is not wise. No fertilizer is better

than the pomace of cotton seed. If they will make it into oil-cake, and feed it to stock, and carefully save and apply the droppings of the animals that eat it, they will keep their lands up.

J. B. Lyman.—Cotton is not an exhausting crop when properly raised. The stalk is not removed from where it grew. There is very little but carbon in the fibre, and this nature draws from the air. The seed contains the most important elements, and the concentrated manures, as guano, phosphate, superphosphate and ammoniated phosphate, have a remarkable effect in making the plant boll heavy. Hence the temptation to use them on all the cotton fields. But after the first year they will do less and less good, except on rank soils, or where the fields are fertilized by farm yard composts. While the cotton is thus stimulated the soil is exhausted, and finally gets down where not even guano will spur it into productiveness. The policy is bad. It is tight at the tap and leaks at the bung. It bankrupts to-morrow to save to-day. On alluvial soil it will do no harm to apply guano and Charleston phosphate. But the swamp planters are not those who use it. It is the hill planters who plow a fine, light, arable, but easily exhausted surface.

Mr. James A. Whitney.—It is a principle in correct farming to return to the farm what we take away from it; it is the custom to supply the cotton seed for the cotton plant. In our later days cotton seed oil is coming into demand. When the cotton seed oil will be made a staple article of trade, it will be necessary to use the cotton seed for that. It is not right to export it to Europe. If they express the oil they should return the pomace to the ground.

Planting of Forest Trees.

Mr. J. Hogeboom, Shea's Corners, Madison county, N. Y.—At the present rate of removal of our forests, the planting of forest trees must yet become a general practice. The unsettled habits of our present farming population are a formidable barrier to even the planting of fruit trees. The farmer has no settled determination to remain where he is; and if he has, he thinks it morally certain that his children will turn their backs upon the old homestead. The sacred memory of the old home was once a guarantee against its alienation for at least several generations. But no longer is this the case to any extent. So much for that moral degeneracy that comes of a mania for speculation.

In this region, where the sugar maple grows so thriftily, and is of

such value for wood and for its saccharine products, it is no uncommon thing to see whole groves of the second growth swept away by the ax, and often where the land is of little value for tillage; whereas, in a few years more, after the winds and other causes had exterminated the maples of the forests, these groves would have become fine sugar orchards, yielding an annual and constantly increasing product of more value than the best crops off the same ground, while the growth of the timber merely would have paid an interest of at least twenty-five per cent on the value of the land. I have some rough land that has been chopped over, and is now well stocked with a second growth of maples. These are to be carefully thinned and protected from the growth of other wood. I want these groves for ornament as well as profit, and as the disappearance of the old forests progresses these groves will be more and more appreciated, as enhancing the value and looks of the farm, while eventually they must increase the attachment of my children to the homestead. A tract, though ever so well farmed, yet denuded of its groves and forests, is wanting in the evidence of a high civilization. This looking *only* to *immediate profit* in dollars and cents is simply a species of barbarism. A wise and comprehensive regard for utility will find gratification in the preservation of groves, and in planting by the wayside, shade and ornamental trees. Utility is always the handmaid of true refinement.

EARLY SPRING THE TIME TO PRUNE.

Mr. Theron P. Parker, Byron, Ill.—At your meeting on February 2d, you answer the question of Mr. Hicks, of Pennsylvania, in regard to the best time to trim apple trees. You say "the best time to prune apple trees is the latter part of winter or March." This exactly accords with my view of the matter, yet you did not tell us why. With your leave, I will try to supply that deficiency. At that time the sap is in the roots of the trees, and if the useless limbs are taken off at that time, when the sap passes into the limbs in April and later, it will all pass into the parts remaining to promote growth and fertility. And the wounds made by taking off the limbs so near the time of the upward flow of the sap, little or no dryness and cracking will occur. Let me illustrate. If thistles or other noxious weeds are cut when in full leaf, they are nearly or quite killed; two or three cuttings will use them up entirely. If done in the right time they are deprived of their vitality. The early part of my life was spent where all the farming land was reclaimed from the

forest. It was customary for farmers having land to clear to let jobs of chopping, &c., stipulating in the contract that all timber must be cut in the summer months or in September, so as to prevent sprouting from the roots of the stumps, and also to greatly hasten their decay. In an orchard which I put out more than twenty-five years ago one tree had its entire top broken off the next spring after setting. In three years after, it had as large a top, and was much more symmetrical than the average of the other trees. But if that had occurred in summer it would have been fatal to the tree. Trees derive much of their nutriment from the air; therefore their bark should be kept thin and soft in spring and summer. A wash of lye will soften the bark and afford some of the natural stimulus, as the lye is an extract from the wood by the process of burning, &c. It should be applied strong to large trees and weaker to small trees.

Adjourned.

March 16, 1869.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Scab in Sheep.

Mr. A. B. Sullivan, Lindley, Sullivan county, Mo., asks for a remedy for scab in sheep.

Mr. T. C. Peters said, in answer to one of the gentlemen present, that it is nothing but the itch, caused by a little insect of the same species as that from which mankind suffers. If the gentleman in Missouri would take the trouble to dip his sheep in a solution of tobacco they would be cured very quickly.

Chairman.—That's good use to put tobacco to.

Mr. J. B. Lyman said that he had discussed the subject with Professor Gamgee, and asked him what they did in England. The Professor had stated that they cured there with tobacco. But he said that dipping them in it was not always enough, for sometimes the wool would be greasy and prevent the tobacco from getting in. He thought that warm tobacco juice should be poured from a tea-kettle, or the like, and the part should be rubbed with the hand.

Mr. T. C. Peters.—I have cured more than thirty with the decoction of tobacco.

Profit from Western Farming.

Mr. Vincent Colyer, curator of the Cooper Union, now traveling at the west, writes from Kansas city, Mo.:

CHAIRMAN OF FARMERS' CLUB: This is the place for young men in want of work to come to. All the resources of a city are here, and railroads diverge in all directions, where farmers can choose good farms at prices varying from one dollar to twenty-five dollars an acre. If he is a laborer he can get work at digging away the banks of sand on which the city is being built, or in breaking stone to pave the streets, or on house building, of which there is said to be over 1,000 under contract to build, and I believe it. Mechanics of all kinds are needed, and these include trades-people to supply them with goods. But, for the Farmers' Club, let me give you a few questions and answers which passed between a fine looking young American farmer and me, at Lawrence, yesterday. He was shoveling his corn from his wagon into a basket for a merchant who had bought it. Q. How much a bushel do you get for your corn on the cob? A. Fifty cents; seventy pounds to the bushel, allowing eighteen pounds for the cob, fifty-two pounds of corn for fifty cents. Q. How many bushels did you raise? A. 1,200, $600. Q. What else do you raise? A. Four hundred bushels of potatoes, which I sell for fifty cents a bushel, peachblooms, $200; 456 bushels of oats, at fifty cents a bushel, $226; twenty-five bushels of white beans, at five dollars per bushel, $125. Q. How many horses have you? A. Three. Q. How many head of cattle? A. Eight. Q. Do you reckon their feed out of what you have stated? A. No. Q. So that you have earned this year, cash, corn, $600; potatoes, $200; oats, $226; beans, $125—$1,151? A. Yes; and garden sauce and little things which I don't count, as my wife takes it out in groceries. Q. How much? A. O, say $100—$1,251. Q. How much did you spend for wages? A. Forty dollars in all, clear, $1,211. Q. Did you buy or raise your cattle? A. I bought three, and raised five; the three that I raised are worth $150. Q. What did you pay for your farm? A. One hundred acres, eighty cleared, twenty wood, $1,800. I began to reckon the interest. He interrupted me with the remark: "You needn't reckon the interest. My farm has increased in value in the three years which I have owned it, by other farmers settling around me and the way I have worked it, seventy-five per cent. I would not sell to-day for $3,500." I continued reckoning: Seven per cent on $1,800 for three years is $378; it has increased in value eighty per cent, or $1,440, leaving net gain on rise of property in three years, $1,062; so that this farmer's increase for the year had been $1,715. When I looked at his fine team, a handsome wagon, and his own

healthy, vigorous form and ruddy countenance, I could not but think of the thousands of poor, puny, complaining young men, whom we all know and sincerely pity, who drag along an existence wearisome to themselves and a burden to all their friends in the eastern States, and wish they were here and could see this country and these people, and judge for themselves. As you well know, I do not own and have not a cent of interest in any land or railroad this side of the Hudson river. I will write you again from the Waschetta Mountains, for which place I hope to leave to-morrow morning.

Mr. Horace Greeley.—This is but a fair and reasonable record for a young man of thrift and industry on those western lands. I believe a million of young men could in four years tell just such a story as this farmer whom Vincent Colyer saw shoveling up his corn. There is some difficulty about it. All cannot work as he does. All are not as thrifty. But hundreds can present a similar record. Not long since I saw a man who went west as a mechanic. Last year he said to me, "I raised 3,000 bushels of grain."

Mr. T. C. Peters.—Is it not possible for a man to make as much, and show as fair a record, by tilling ten acres as a market garden near New York? The value of land is produced by labor, and by nearness of markets. I think a market garden, one-tenth as large as this Missouri farm, may yield as much.

Mr. Horace Greeley.—Some, I admit, might do as well on a tract of Jersey land as on Long Island. But the majority of young men can raise corn, wheat and barley, much better than they can asparagus and cauliflower. Nearness to market is a constantly fluctuating term. The most western pioneer may now find in the Rocky mountains a better market than the Jersey market gardener. Railroads and waves of migration are constantly shifting markets, and the study of these causes on prices of farm products cannot be neglected by any farmer who would understand his business.

Mr. T. C. Peters.—Will Mr. Greeley or some other member of the club define what he means by the value of land. If five acres of asparagus will bring me as much money as fifty acres of wheat, in what sense is the asparagus garden less valuable than the wheat field?

Mr. Horace Greeley.—In theory this may be sound reasoning. But as a matter of actual trial, the five-acre farms have not been found enough. It has been tried at Vineland, and the general opinion is that Mr. Landis made a mistake in carving his land into five-acre patches. A man wants some timber land and pasture. He wants

room, and can't get it on five acres. I don't advise any man to take a piece of land and go to work to make a living by farming unless there are twenty-five acres in his tract.

Mr. T. C. Peters.—How is it with the Belgian peasants?

Mr. Horace Greeley.—They live, many of them, on two or three acres. But they seldom eat meat; for fuel they use little sticks and weeds. If a man wants independence and substantial comfort in farming let him get 100 acres. I was talking with a man in Illinois, who gave $125 for his land and now he is selling the timber alone from the surface at $100 an acre. Let the young men of this country buy land, and buy it now before it gets beyond the means of men in moderate circumstances.

Mr. Wm. Lawton.—The subject is of great importance. There is a vast number of young men who can raise a capital of from $1,000 to $2,000. If they remained here it would soon be exhausted; if they would take it and their intelligence, and settle out there, they could raise families and make permanent homes. If you refer them to the old farms in New Jersey, it is like referring them to other business where a great deal of money can be made and spent at the same time. If a man settled out there, he is certain to make an independence. Living here, he has no opportunity to enlarge his advantages.

In 1828 he had been thrown into the possession of land in the interior of Pennsylvania. He found within a hundred miles of Philadelphia a population all German, who got the land at fifteen dollars per acre. There they were in comfortable circumstances. They made their own clothes; educated their own children. The young farmers were all married, as a general rule, and there was no difficulty in getting a living. They all had increased their establishments; they had sheep and cattle; they had log houses, and made their own furniture; they were happy and contented. Talk about business in New Jersey. There is a certain class to do that, but we do not want the million to go there. We want room for the million. Where is it but out on such land as this? In a few years they could become independent men, and get married.

DONATION OF JERSEY MARL.

A letter was read from J. C. Stevens, President of the Squankum and Freehold railroad, offering the club fifty tons of Squankum marl free of freight charges.

On motion of Mr. Greeley, the club accepted this handsome present

with thanks. A committee of distribution was appointed, consisting of Messrs. Isaac P. Trimble, Prof. Tillman, Joseph B. Lyman, Horace Greeley, and William S. Carpenter. Members of the Institute and others engaged in agriculture who desire to make trial of this fertilizer, and who will report the issue of their experiments to the club, are invited to leave their address with the secretary, J. W. Chambers, and a memorandum of the quantity they wish to have shipped.

Apple Grafts.

Mr. Daniel B. Bruen, Newark, N. J., now brought forward a number of cions of the apple, and read in connection therewith a report, of which the following is the substance: This is the Harrison apple; its origin is in Orange, Essex county, N. J., and named after Simeon Harrison, owner of the farm. It is the most celebrated cider apple known. It bears large crops, fruit small. Eight bushels produce one barrel of cider; it is very rich in saccharine matter. This, the Campfield apple, has its origin in Newark, named after Matthew Campfield, one of the first settlers of Newark, almost universally used in the proportion of one-third with the Harrison apple in manufacturing the celebrated Newark cider. The fruit is rich in saccharine matter, and keeps well until spring; good for cooking, very little better for table use than a well-soaked cork from a cider bottle. The Orange apple is not a good cider apple; ripens September to December. The King apple originated near Sag Harbor, Long Island, some 150 years ago. Is not a cider apple, though a favorite for the table and family purposes. The Granny Winkle does well when mixed with the Harrison to form cider, first-rate for cooking for table use. The Red streak does well to mix with the Campfield and Granny Winkle to make fine cider. It is as sprightly and effervescent as champagne. The apple will keep almost as long as a leaden bullet, and is as difficult to bite. Porter apple not rich enough for cider. It originated in Newark. A most superior one for cooking and table use.

Making Cider.

The proper mode of manufacturing cider is but little understood out of New Jersey. Walden, in his soil culture, says that "the careless way of making cider is too well known;" he properly describes the time for gathering apples, and taking care and preparing the fruit to be manufactured into cider, and is correct in saying

that the apples should be ground fine, but displays the most consummate ignorance of manufacturing the liquor after the apples are ground. I am now in my seventy-sixth year, and have been acquainted with table and cider apples of Newark and its neighborhood, and the manufacturing of cider, from my childhood. In the month of November apples were gathered with care to manufacture fine cider; the fruit was kept to ripen until the last of November and first of December; the apples were ground with care and placed in the press with clean straw, and, as the cider is pressed out, it is put into clean casks and placed in a proper vault-cellar or building upon skidds, with the bungs out. After the liquor goes through fermentation, the cider is drawn off, the barrels washed, and the cider put again into the barrels, when it goes through a second fermentation, after which it is again changed into clean barrels, and goes through a third fermentation, when it is sucked off again into clean barrels, and is then considered in a merchantable condition, and fit for bottling. When cider is bottled the faucet should be placed in the barrel, and the cask placed in the exact position in which it is to be drawn from, and left to stand not less than two or three weeks, and the barrel kept quiet in its place until the cider is drawn from it; the bottles may be corked up as soon as filled with perfect safety against bursting. Whatever fixed air there may be in the liquor will not act until the atmospheric air comes in contact with it, unless some of the sediment from the barrel has got into it. Cider properly manufactured, bottled, and well corked, without anything whatever added to it, and placed on the side in sand in a cool cellar vault, will keep for many years.

HOW TO PLOW DEEP.

Mr. S. Edwards Todd read the following paper:

"After all the valuable suggestions and brilliant lucubrations that have been offered touching the subject of deep plowing, the beginner will be interested to learn how he may plow his heavy and compact land ten or twelve inches deep, with only a single span of horses, or with one yoke of oxen.

"As a great many plows are calculated to run only four or five inches deep, they cannot be made to work at all satisfactorily when they are adjusted to run ten inches in depth. Therefore, the first important consideration is to obtain a plow that has been formed with a direct reference to deep tillage. When a plow is correctly adjusted,

and the team hitched to it, with the proper length of traces or chain, if the various parts have been constructed in accordance with correct mechanical principles the implement will run alone, where there are no obstructions, and maintain its correct position. In a trial at New Haven with one of Mead's conical plows, after having adjusted the traces, clevis, and gauge-wheel, I let the plow run without holding, and those present will testify that we plowed eight times around the land without my touching the handles, except at the ends, when turning around. This fact will show to beginners that if their plow does not glide along easily, like a canoe over the water, it is not properly adjusted, or the parts are not all correctly constructed. When adjusting a common plow for deep work, with a single team, the better way is to cut narrow furrow-slices, letting the implement run at the desired depth, rather than attempt to plow two or three times in the same place to pulverize a foot deep. When a "deep-tiller" plow is adjusted to run a foot in depth, a single team may draw it, even in compact land, provided the whiffle-trees or the ox yoke be so short that the plow will run naturally, without any laborious effort of the plowman to keep it erect, and cut a slice four or five inches in breadth. In order to do this the ox yoke must be as short as it can be and allow the oxen to stand straight, side by side; and the whiffle-trees should not be more than twenty-two inches in length. When plowing deep in this manner I have been accustomed to use a double whiffle-tree only twenty-one inches in length from the middle of one single-tree to the other. By this means, it was easy to adjust the plow to cut only a very narrow furrow slice.

"By adjusting a plow to cut only a few inches in width, the pulverizing will be as complete as by thorough spading. Of course it will be understood that sod ground cannot be plowed with such narrow furrow slices when it is desirable to turn the sod under.

"Another important consideration is a sharp plow-point with a fin-cutter; or a sharp coulter may be employed to cut the furrow-slice loose. A sharp coulter correctly adjusted, or a sharp fin-cutter on the plowshare, will often reduce the draught of the plow from twenty to forty per cent.

Deep and Shallow Plowing.

The chairman said that they would now try to finish off this question. He proceeded to read the many letters on the subject that they had received.

Mr. S. Kimball, Oconee, Selby county, Illinois, says that deep plowing is the rule there. The best of farmers are beginning to plow deeper. Last year he plowed land eight inches deep for corn.

Mr. Lewis Brandt, 517 Sixth avenue, New York city, says: A good farmer will plough deep in the autumn, and use a plow which has a small plow in front, which cuts the sods off, throws it in the furrow, where it is covered by the loose dirt from the larger one; this will rot the sod; the soil will be warmer; will keep warmer all winter, and in spring on deep plowed land snow will melt eight days earlier than upon that which is unplowed. Through the fermentation of the sod the pores open and admit the water. By shallow plowing, most of the grass and weed roots nearest to the top soil will keep alive, and cannot be destroyed by the cultivator or harrow, and will grow as fast as the new crop put in; the ground will not be as warm, as by the deep plowing it does not retain moisture as long. Plowing deep in the spring will bring soil to the surface which is not fit for vegetation. By deep plowing, even in spring, the perfectly covered sod will rot and act advantageously to the crop, and will give a better yield than by shallow plowing in spring. He who plows deep in the autumn will make very large crops, have plenty to eat, feed, and sell, and keep his stock as much as possible in the stable to save all manure. The spring plowman will make in one unfavorable year small crops, and often fail entirely; he has nothing to eat, feed, or sell; his stock runs about the whole year, and he loses all the manure.

Mr. A. G. Bisbee, of Chester Cross Roads, Ohio, says that deep plowed land never dries as quick as land shallow plowed. Four years ago I bought a lot for planting a vineyard, very badly worn; had been under cultivation for forty years and probably not a shovel of manure had been put upon it. It is the highest point of land in northern Ohio, being two hundred feet higher than any other land, except that in the vicinity. I plowed it with two teams and two plows, one following the other in the same furrow, and throwing up the subsoil to the top. I planted out my vineyard, and planted a row of potatoes between rows of grape roots. The potatoes turned the finest in the country. The earth kept moist all summer to within an inch of the surface. Another object in deep plowing is to bring up the clay, which is one of the elements necessary for vegetable growth, especially the blue clay, after being exposed a few years to the influence of the weather. He then cites instances to prove his asser-

tions, and says that he does not think that he will ever go back to shallow plowing.

Mr. David Boyd, Lake Ridge, Mich.—He says that he plowed his land from four to six inches, and sowed some of it with wheat. It came up well at the fall, but lost root badly in the winter and spring. The result was only eight bushels the acre. In the spring I plowed a piece of corn stubble in the same way, sowing one-half to oats and planting the remainder with corn. The oats started well, but shrivelled up before harvest, and only yielded about twenty bushels to the acre. The corn dried out at the close of the season, and was nearly a failure. Then I plowed down ten inches. I got this fall twenty-two bushels per acre of wheat; from another piece I got fifty-four bushels of oats.

S. H. McConnel, Rockville, Chester county, Pennsylvania, says, that, setting aside his neighbors' and his own experience, he broke up a field for corn of rather a light loam, with a red clay subsoil, deep enough to turn up one or two inches of this red subsoil. He harrowed thoroughly and planted. The corn came up pale and sickly, and never yielded anything but a crop of nubbins. The next plowing turned out no better. He now plows four to five inches deep; is careful not to touch the subsoil, and never fails, without manure, to raise from fifty to eighty bushels shelled corn per acre. He believes in stirring the soil as deep and as often as you wish, but at the same time keep nature's plan in view, by keeping the best soil always on the top. Shallow plowing is not only practiced throughout his county, but also in the adjoining one, Lancaster, the garden of the State, or, we might say, of the world.

Mr. Archibald McVean, Avon, Livingston county, writes that there was a road in his farm which he wished to plow, but it was so hard that he had to give it up. He, however, sowed it as he did the surrounding land, thinking that it would come to naught, "but there was some dust and some lumps of clay on the track, and the harrowing partially covered some of the seed, and a lively rain sprouted even that which lay in sight. I looked for it to perish from time to time, till near harvest, but every time I looked I noticed a ranker growth of wheat on that road track than any other portion of the field, and the best yield at harvest."

Mr. G. S. Bentley, Green Hill, Columbiana county, Ohio, says: About three years ago I took charge of a farm of fifty acres. It was naturally a good sandy soil, rather hilly, subsoil on the more elevated

portion gravely, on the more level portion clayey. With shallow plowing, no stock, no manure, and the ruinous system of farming to which it had been subjected, the average of wheat per acre was about six bushels. I have been plowing seven or eight inches instead of three or four, keeping all the stock it will bear and applying all the manure to the land plowed, and plowing none without giving it a portion of barn-yard manure, and to seed down to clover just as soon as the soil is in proper condition for it. The result has been an average of twenty bushels wheat per acre; oats, thirty; corn, forty-five to fifty. I attribute this result to the deep plowing more than to any other cause.

Mr. Charles A. Eggert, Iowa city, Iowa, says: In regard to deep tillage, allow me to offer a remark or two. Many writers, etc., who favor deep tillage fail to admit that all that is to be attained by deep plowing, trenching, etc., has sometimes already been done by nature herself. Mr. Snow, of Michigan, refers to the practice of sowing wheat in the timbered land by simply harrowing it in, as a proof that deep plowing is not required to secure large crops. He evidently overlooks the palpable fact that in timbered land the roots of the trees have already most perfectly done what the plow would only less perfectly do in prairie soil.

The principal advantages of deep plowing are in the fact, that deeply plowed land is more open to the influence of the atmosphere; that it is sooner warmed in spring, and retains its warmth later in the fall; that it has better drainage and more capacity of retaining moisture; and that it enables the roots of plants to enter the soil more readily, and to accommodate themselves to the conditions of drouth or severity of seasons.

All these advantages are possessed by a timber soil, especially after the roots of the trees have decayed in some degree. This is very apparent in the entire western country, where the timber and prairie alternate. The principal reason why so many of our fruit trees in the west thrive in timber soil and get winter killed on the prairie, is, because in the former an equivalent of deep plowing exists, while, until recently, plantations of fruit trees on the prairies were made on imperfectly prepared soil. At present, deep tillage of the prairie soil is generally conceded to guarantee the very best success of fruit and other culture.

Directions for the Sugar House.

Mr. G. W. Carleton, Brunswick, Maine.—Last November one of your correspondents made inquiry about maple sugar. I will attempt to tell him what his trouble arises from, and the reward of "as handsome a cake of sugar as can be made in the State" he may pass to you to be shared by the club. He boils his sugar so high that it retained no moisture after being granulated, or he keeps it in some tub, keg or firkin which allows all the richness to filter out of it. Boil it slacker; don't let it filter; seal it up like canned fruit, and it will never lose its peculiar rich flavor. If he or any one else has any maple sugar which has become inferior by age, and if the crop is short this spring and you have any left over, and you want to avail yourself of a quick market and good paying prices, remelt your old sugar to a syrup, then reboil it to a granulating pitch, which is easily known by taking out a little with a spoon, and dropping it into a cup of cold water; if just right to grain, it will form readily into a *soft* ball in the bottom of the cup. Grain the sugar by stirring while hot. If too hot, the sugar will be in *fine*, close grains. Have it boiled just right, and just as hot as a finger thrust into it can be borne, and if the sap or syrup has been kept *sweet*, not kept so long or so carelessly, or so thin as to become sour, the sugar will be in coarse grains, and of far richer flavor, and by stirring into it a small quantity of sugar that has been pounded fine, it will grain in half the time, and be as good as he can wish for. If maple sugar is wanted by some of our pioneer families, "*way back*," beautifully white, for "*company*," take a common earthen pot, and with a drill, or nail, make several small holes in the bottom of it. Lay over these a small piece of coarse cotton or muslin. Now fill the pot with newly granulated sugar to the top, crowd the sugar down so as to settle it sufficient for a cake of clean clay, made soft as putty, which, after covering the top of the sugar with a piece of thin white paper, or wet cotton cloth, lay on the cake of clay and press it down upon the sugar, so as to fill the pot. Now cover the pot with a plate to keep the clay clean and moist, set this pot of sugar on the top of an empty one, and set the whole away in a cool cupboard. The drippings, which will fall into the under pot, will be most deliciously rich, and the sugar in the pot from which they were drained will be white and nice enough for the "company," if it does not come too early, but its peculiar maple flavor will be greatly departed, for in proportion as the sugar contained this moisture it is rich or otherwise.

Adjourned.

March 23, 1869.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

GRAIN IN BUTTER.

Mr. Homer Hickok, Watertown, N. Y., asked if butter is better having a grain than without. "What causes this grain, and of what is it composed? Is it really composed of anything, or is it merely an appearance; then how do you produce the grain?"

Mr. J. B. Lyman.—When the butter cuts like good green cheese, and does not stick to the knife in warm weather, we call it of good grain. When it cuts like lard, the grain is bad. No high-priced butter has bad grain. Many circumstances must be just right in order to secure high quality in butter, but three precautions cannot be dispensed with, if Mr. Hickok would get the highest prices: 1. The cows must eat sweet upland grasses, or fine early cut hay; 2. Neither milk, cream nor butter must be, for any considerable time, warmer than from sixty degrees to sixty-five degrees; 3. The butter must be worked right, and not too much.

Mr. S. Edwards Todd.—The grain of butter is the name given to a certain appearance of prime butter, which can be perceived only by the experienced eye. In reality, there is no such thing as the grain of butter. But, for want of a word which will express that appearance, dairymen have called it grain. It is that peculiar appearance of good butter which assures the experienced eye, at first sight, that every operation connected with the manufacture of that butter was performed just as it should be. That which we denominate the grain cannot readily be described on paper. Perhaps in two-thirds of the butter that is received at the New York markets no more grain can be perceived than in a cask of tallow or a pot of lard. Let the grain of butter be pointed out to a person who has not had long experience in selecting and tasting butter of a prime quality, and he will be puzzled when he attempts to designate the grain to a beginner. When butter has been made of poor milk, which was kept, while the cream was rising, in a close and poorly ventilated apartment; when the churning was done when it seemed to be most convenient, and the butter worked when the dairyman or maid had no other employment, and has been worked too much, or not enough, we may look in vain for the *grain* of butter. When butter is worked by means of a roller, by squeezing or kneading it with the bare hands,

or by crushing and smoothing the surface by pressure, the best of butter will appear waxy and sticky when tasted, and will exhibit very little or none of that peculiar appearance which is called *grain.* Butter should never be smoothed and crushed while it is being worked, as such manipulation tends to destroy the grain, by rendering it "salvey" or adhesive. Prime butter that has been made of the shining globules that were gathered among the fragrant clover, that has not been worked too much, will not adhere to one's lips and teeth, any more than a piece of a Bartlett pear. On the contrary, butter that has been worked too much, that has been crushed with a ladle or with a roller, will be divested of all granular appearance, and will adhere to one's teeth and lips like tallow. There is *science* in working butter. The mass should be gashed through and through, to allow the buttermilk opportunity to escape into the gashes. Then, as the gashes are closed, the milk will all flow out, as it cannot be forced again into the butter. More butter is spoiled by overworking, by crushing, grinding beneath the ladle or roller, or with the bare hands, than any other way.

To Raise Watermelons.

Mr. B. F. Stanley, Greenville, S. C., wrote: "As a small return to others for their knowledge, I give you our plan for raising watermelons. Holes dug two feet square and eighteen inches deep, twelve feet apart, filled with fresh stable manure tramped down, the surrounding soil drawn over; or, better still, fresh soil from the woods or corners of fences mixed with road sand, a broad, flat hill, like an inverted saucer, a little well rotted manure or guano slightly raked in, some coal dust to absorb the sun's rays, which also prevents forming a crust. Second, seeds left, never work them when the dew is on them, nor disturb the vines, but work them thoroughly; let no grass or weeds appear. Our weights from twenty-five to forty-five pounds. Our best varieties, the Orange, bankright, and Bradford."

Oats or Shorts for Food.

Mr. G. W. Fisk, Coldwater, Mich., requested the opinion of the club as to the comparative value of oats and common bran or shorts in feeding milch cows or sows with pigs. "Which will best develop the frames of young animals with the least expense, with oats at forty-five cents and shorts at one dollar per hundred? After several years' experience in cutting feed for both horses and cattle, I am entirely

convinced of its utility. In the past seven years I have not lost a single animal, and have had no occasion to resort to medicines or the veterinary surgeon. It is the most economical way of feeding both fodder and grain; it promotes the health of the animal. The feed, when moistened and mixed with ground feed, produces a development more nearly like grass than if fed dry."

Mr. T. C. Peters.—A bushel of oats weighs thirty-two pounds, and so 100 pounds would cost one dollar and thirty-five cents, while it is a cent per pound for bran. But bran is the most profitable feed for milch cows than any I have ever used. Oats I have never fed to milch cows, but I have given them to the calves. I would as soon have bran as oats to feed cows. All things being equal as to price, I would sooner have bran than oats. I do not know the relative value in making milk, but I think oatmeal would be the best to make milk and to make bone, as in young cows it is much the best.

Mr. J. B. Lyman.—The State has appropriated $6,000 to ascertain the cause of disease among breeding cows, but no affirmative result has been reached. Inquiring among the farmers where this malady is the worst, I have found the herds that suffer most are fed on the hay of old and exhausted meadows, and slopped with corn meal. In this food there is little albumen, little from which the animal can make either curd or bone, and being called upon to do both at the same time, nature gives it up. The heaviest milk is not the richest. Some milk will make a pound of cheese from eight of milk, some from twelve. When an animal has young to perfect she should have food rich in flesh and bone material, in that which makes milk heavy. Wheat shorts is such food; so with good, heavy northern grown oats. It is not well to feed whey only to sows with pig. They should have the curd in some form, or else wheat bran and shorts should be fed with the whey. This trouble with the cows has arisen since railroads and steamships have made it practicable to consume milk far from where it is produced. It seldom originates in butter dairies. Bonedust on the pastures and meadows, with wheat shorts in the winter, in place of corn meal, will rid us of this disease.

Mr. T. C. Peters.—I used to feed bran to a number of ewes, and lost the lambs by abortion, and when I stopped the bran this abortion ceased. If attention is to be paid to chemistry it will be found that oats produce more growth of animals than anything else. In Scotland, where they use nothing but oatmeal, you see the men very strongly developed.

When to Sow Clover.

Mr. J. D. Ackerman, Union city, Michigan, asked "if it will do to sow clover about the middle of June with buckwheat and get a good catch? I have a field I wish to seed. The land is too wet to get in proper condition early enough for oats. Would it do any better with Hungarian grass?"

Mr. S. Edwards Todd.—Leave out the buckwheat and sow the grass seed alone. The best way to seed down is not to plant any crop at all.

Mr. Wm. S. Carpenter.—I have sown clover seed as late as 1st June. If sown with buckwheat or rye the seed is more sure to take and look well; and where weeds alone accompany the grass seed they are very apt to destroy it in my experience.

Mr. S. Edwards Todd.—With all respect to Mr. Carpenter, I say, that there is a good deal of error in regard to seeding farms. The farmers have had it driven into them that they must sow something with the grass seed before they can get a catch. I thought so at first myself, but I have changed my opinion. It is better to sow the seed alone on prepared ground; the difficulty in securing the catch arises from not having the ground properly prepared. The ground wants to be prepared as for a carrot bed. The seeds are very small and tender and cannot grapple with lumps. The ground must be pulverized. Whenever a load of hay is turned over in the streets, how the seed will spring up on the hard beaten path.

Mr. P. T. Quinn.—What time would you sow it?

Mr. S. Edwards Todd.—Whenever I got the ground ready. If it were not under a state of pulverization till July I would wait then.

Mr. Wm. S. Carpenter.—It is hardly safe to put in grass much after July. If accompanied with grain it is more likely to succeed.

Mr. Louis Brenelt, New York city, wrote to offer a few suggestions to the club. He said: "While a grain crop is growing and beginning to bloom, but very little strength is taken from the ground, but when the grain *ripens* the ground becomes impoverished. In like manner, when grass for hay is left to bear seed, the soil is similarly affected. But the soil is most impoverished by raising plants of which the seed produces oil. A better crop of wheat can be raised without manure, after clover mowed in blossom, than can be raised even when the ground is well manured after clover mowed in seed. Most farmers let their hay get too ripe, by which they hurt their land more than they are aware of, and thus the soil becomes so poor

that they are unable to raise without difficulty any other crop. On an average, farmers raise no more than two tons of hay to the acre. By irrigation they could raise from four to six. If irrigated, land worth now from ten to fifty dollars per acre would be worth from $400 to $500 per acre. The offal, if carefully collected, would feed millions of fowl. Poultry raised so near market would also come in in much finer condition. The same thing would be with lambs, sheep, and other stock. Poultry, like other stock, should be raised at some distance from the city, and the farmers living near the city should prepare them for market. My opinion is that the Farmers' Club should influence the State government to employ highly and practically educated commissioners, paid by the State, to advise the farmers gratis to make the above mentioned improvements, in the cheapest possible manner. It would be of greater benefit than the model farms, as they are local.

PLASTER ON STRAWBERRY BEDS.

Mr. B. V. E. Pratt, Alaska, Kent county, Michigan.—I prize your club reports highly, and receive a great deal of instruction which I wish to put into practical use in working my farm, which is a new one. But I write you more particularly to inquire of the club, or some of its many correspondents who may know, as to the effect which plaster of Paris will have on strawberry plants, which grow in our fields in great abundance, and which some of our neighbors say will be destroyed by using plaster as a fertilizer. Not having experience, I should like to be informed if it is detrimental. If it would be so, if not sown on the ground occupied by the plants, but used on other crops adjacent. I should like to know which kind of soil is better for growing strawberries, a sandy loam, or a clayey soil, both equally well prepared.

Mr. J. B. Lyman.—The cultivators of the strawberry have never found plaster a valuable manure. Its effect is to grow stalk, not fruit or seed. Applied to fields that abound in strawberries it will be likely to make clover grow, and drive out the strawberry, or else it will give you rank leaves and stems, but few berries. The Wilson, the Brooklyn, the early scarlet, and some others, will do well on sandy soils. The Triomphe de Grande will not. It needs a cool clay loam.

Roots for Food.

Mr. H. Heberling, Mount Pleasant, Jefferson county, Ohio, writes: "After an experience of more than thirty years feeding roots to cows and stock ewes, I am convinced that more than half the value of roots (nature's substitute for green pastures) is almost entirely overlooked. Observation has conducted me to the following conclusions: 1st. The succulent and alterative properties of roots are essential to the healthfulness of ruminating animals when excluded from green pastures; 2d. In addition to the large amount of actual nutrition in roots, they impart to meal, grain, hay, and other dry food, juicy and alterative properties, that so modify the dry food as to render it doubly valuable in sustaining the animal economy; 3d. With one peck or more chopped roots to each cow morning and evening, our cows are in as good condition, and yield as much rich milk and butter during winter and spring, as summer and autumn. I add the roots to the other food to secure the best results; 4th. Breeding from 400 to 500 ewes, commencing to drop the lambs about the middle of March, we can raise as many lambs as ewes, without starving any for want of milk; 5th. Cows are not subject to painful and protracted parturition, abortion, hollow-horn, wolf-staggers, or hollow-belly, which last, to the shame of owners, takes off so many valuable cows in the spring season; 6th. In nine cases out of ten, the above diseases are merely symptomatic, and originate in deficient and unwholesome food, and are traceable to dryness of the manifold (vulgarly called) followed by ceasing to ruminate, and where the follicles of the stomach become indurated and entirely inactive, death must follow. One acre of sugar beets would save a herd of six cows from all the above troubles, and owner from the losses of animals, butter and milk, and, in addition, furnish as much food as ten acres of oats. Why do not dairymen cease to feed those fermented, stimulating, unnatural slops, and feed roots in winter? A poor, unhealthy cow cannot make healthy milk."

Distribution of Iona Grape Vines.

The chairman distributed 100 Iona grape vines, the gift of Mr. R. W. Holton, Haverstraw, N. Y., who considers this variety the best grape now grown. On motion, the thanks of the club were passed to the donor.

White Beans—How Planted.

Mr. Joel Zook, Madisonburg, asked: "Should the common white bean be planted in hills? If so, how far apart each way, and how many to a hill? Or should they be sown broadcast? What time should they be planted? Are they as profitable as a crop of potatoes?

Mr. W. S. Carpenter.—I have planted them occasionally. We plant beans at the times we plant Indian corn, never broadcast. We cover them with the plow the same as Indian corn. The yield is thirty bushels to the acre when it is good. We do not consider them as profitable as potatoes. Last year they commanded from four to five dollars a bushel.

Mr. A. S. Fuller.—But he may be a long way from market, and so the beans may be more profitable than potatoes. The profit depends upon where he is located; the former are more easily transported than the latter.

Mr. S. Edwards Todd.—There is one point in regard to the preparation of the soil. The true management is to work over the land three or four times and destroy as many as three crops of weeds before they are put in. In June put them in with a drill by stopping up every other tube. We put the rows about sixteen or eighteen inches apart, and then the crop comes up so quickly and gets such a start of the weeds that all necessity for hoeing is avoided.

The Agricultural Press.

Mr. S. Edwards Todd then proceeded to read a paper upon "The Spirit of the Agricultural Press then and now":

About thirty or forty years ago a printed article on an agricultural subject was looked upon with no little amazement. Indeed, an attempt to instruct and aid the tillers of the soil through the medium of the press was scarcely thought of. The only agricultural periodicals in the whole country were the *Genesee Farmer*, Rochester, N. Y., edited by the present senior editor of the *Country Gentleman*, and *The Cultivator*, published at Albany, by Hon. Jesse Buel. In many instances the farmer who received an agricultural paper was reproached with the taunting epithet of a "book farmer." Nothing seemed to strike the tiller of the soil as a topic so superlatively ridiculous and absurd as an attempt to instruct a farmer in the art of raising grain or breeding domestic animals through the medium of the press. Go to the library of the American Institute and examine the old volumes of these two illustrious pioneers, the *Genesee Farmer*

and *Cultivator*, both of which started out in the magnanimous enterprise of improving the soil and the mind with as much trembling and apprehension as filled the mind of Christopher Columbus when he loosed his cable and launched on the broad Atlantic, dreaming each wind and star his friend as he sailed for the shores of the western world. The key-note of the agricultural press *then* was, "Agriculture is the most honorable employment of man." And that idea, properly expanded by illustrious statesmen, embraced about all that was thought worthy of publication. If an agricultural address were to be delivered, some governor, ex-president, or some illustrious judge must be the speaker. And we usually formed a fair idea of the entertainment beforehand, as the theme usually was, "The dignity of manual labor; or, the transcendent nobility of the calling of him who follows the plow and of her who milks the cow." Everything of an agricultural nature that was put in type was of such a vague and general character that a beginner could learn nothing of value from it, unless he had first been taught what the tyro must understand before he can perform the first and simplest operation in agriculture. Farmers would confer together about this and that, devising the most appropriate and judicious means for accomplishing a given result. But let their deliberations be brought out in an agricultural journal, and the man who would read them and be influenced by such recorded suggestions was a target for the jeers of the whole town, who would point sneeringly to every broken rail in the fence, to every noxious weed on his farm, to every inferior animal, and to every poor crop of grass or grain, as an illustrious example of "book farming." But, at the present day, how changed. When a person is wanted to deliver an agricultural address, do they seek the governor, the judge, the political demagogue, or some young swell to portray to his hearers the poetry of agriculture and to proclaim the honors and glories of kid gloved, morocco boot, and silk velvet agriculture? By no means. That kind of instruction is well nigh played out. But the man who can *tell* something about his vocation, who knows from experience what to do and can tell you how to do it, and who does not recoil at the sight of a tow frock and India rubber boots, and who can take hold of almost any farm implement and teach a beginner how to handle it, and who can hold up hands calloused by practice, *he* is the man to talk on agriculture, even if his sentences do not read as smoothly as the paragraphs of Blair's rhetoric. The regular frock-and-trousers farmers are the men who

are destined to control the agricultural press of our country. Farmers want facts. They have been treated to a liberal supply of rhetoric. The million want and will have agricultural and horticultural matter to read. The man who does not read one or more first class agricultural papers, and aim to make his system of management coincide with the teachings of agricultural science, is now looked upon as an old fogy fit for treason, stratagem, and spoils; and the publisher of a periodical who aims to succeed among the rural population understands very well that agriculture, horticulture, pomology, floriculture, and other arts intimately connected with these, must occupy a prominent place in his publication, or the million will feel indifferent about subscribing for it. Publishers are beginning to appreciate this fact and to employ writers of the first talent to supervise their agricultural departments, as they have learned, after more than a score of years, that people in the rural districts will usually read *first* that which concerns them most, or which is likely to be of most advantage to them in their secular affairs.

The paper was concluded with a list of the newspapers in the United States which make the discussion of agricultural topics a special feature.

MANURE.

Mr. Seward Mitchell (Maine), being present, asked if manure lost its strength by being spread upon the ground and remaining there for a number of months. He said he always spread manure from the wagon on the land at once, not leaving it in heaps.

Mr. Horace Greeley.—In reference to the manure, I think it depends on the time of the year. If our friend had put his out in a hot, dry month he would have lost half of his manure. I should say the 1st of November was the best time to get it out; but earlier than that in this latitude there would be danger of wasting it; but in Maine September would be the same as November here.

Mr. A. S. Fuller thought it would make a difference as regards the character of the manure. If it was old, decomposed barn-yard manure there would be no danger of its deteriorating.

BLACK SPANISH FOWLS.

Mr. C. G. Boardman, Vermilion, Oswego county, N. Y., writes as to the doings of his hens. He says:

My fowls are of the Black Spanish variety. I usually feed screen-

ings, and occasionally change to corn, buckwheat, &c., keeping feed before them at all times. I give them fresh water every day, and at all times have a supply of ashes, sand, lime, &c., for them to go to. Occasionally give them fresh meat. I might add that, living in a village, I am obliged to keep my hens shut up about half of the year, as I do not allow them to trouble my own or my neighbors' gardens. I have a small inclosure, (about 10x20 feet) for them to run in.

No. of hens	12	
Total eggs, dozen	122	
Average price per dozen, 22½c		$27 45
Chickens and droppings sold and consumed		5 87
		$33 32
Total cost of feed		14 25
Showing a profit of		$19 07

ALDERNEY STOCK.

Photographs of some of the choice cows in the famous herd of Charles L. Sharpless, near Philadelphia, were presented to the club. Dr. Isaac P. Trimble mentioned the superiority of these cattle, especially for butter dairies.

ASHES.

Mr. W. A. Young, Cumberland county, Pa., asked the following: I wish to plant potatoes in a piece of new land; it is a stiff blue grass sod, and very heavy soil (limestone). Would coal ashes be of any benefit to lighten it? How many one-horse loads to the acre?

Mr. S. Edwards Todd.—A thousand.

Will a compost of hen droppings, coal ashes and plaster make a good top-dressing for corn? About what proportion of plaster should be used?

Mr. Wm. S. Carpenter.—The top dressing, without the coal ashes, would probably be as advantageous.

Mr. A. S. Fuller.—Coal ashes are valuable, if put on a sandy soil, but I consider on clay soil they are not worth drawing a mile.

Mr. R. W. Holton.—I would use them on clayey soil for the purpose of opening the soil. As a manure, I would not draw them half a mile.

Mr. Isaac P. Trimble.—The question has often been asked, "Are coal ashes of any use?" This could only be proved by experiment. I ask this man to try Mr. Todd's recommendation, and put it on at

the rate of 1,000 loads an acre, and report to this club as to the benefits derived.

Mr. P. T. Quinn.—He does not state whether it is bituminous or anthracite coal. If it is hard coal ashes there is not very much fertilizing material in them. I think that Mr. Todd states too much in giving a thousand loads to the acre; a much less quantity would produce the same result. I use it on heavy clay sod at the rate of thirty-two loads to the acre. If I were he, I would plow in the fall, and, before he plants in the spring, plow twice. This would lighten the soil more than the coal ashes. The compost that he speaks of I would mix with earth before applying to the soil. It would do as well without the coal, however, and thus save him the trouble of drawing them.

Mr. D. B. Bruen.—I used the compost for corn, and it is very useful.

Mr. S. Edwards Todd.—The quantity that I have mentioned looks wonderfully large, but when we come to divide it up into the yards and perches of an acre we find that it is nothing more than would be a heavy sprinkling of salt upon our meat.

Mr. Brainell.—It would cost more than three crops would pay for.

Mr. D. B. Bruen.—Coal ashes upon the ground will certainly open it and give it air; that is what the ground needs.

Mr. A. S. Fuller.—How do they know that there is any food for plants in them? Chemistry knows nothing about it.

Mr. Wm. S. Carpenter.—The amount of fertilizing material that is in coal ashes is due to the ashes of the kindling wood. But I think it aids the soil, by reason of its acting mechanically; but as a fertilizer it is not worth a straw. There is no evidence that there is any fertilizing property in the sands of the sea, yet plants may be grown largely in it.

Mr. A. S. Fuller.—I do not say that there is any fertilizing material in coal ashes, but I say that the effects are evident from their use. My neighbors say when they are applying lime that they are putting on manure. I tell them that they are not doing anything of the kind. Now, there is something in it; what is it?

Mr. E. Williams, Mt. Clair, N. J., said that he has seen ashes tried in a garden, and never was there a more luxuriant growth.

Mr. P. T. Quinn.—We know that there are certain materials in guano; the chemists inform us of the constituents.

Dr. Lewis Feuchtwanger.—There is as much difference between coal and wood ashes as between night and day.

Barley after Corn.

Mr. J. H. Breckbill, of Lancaster county, Pa., in answer to a letter inquiring about the matter, wrote:

"Yes; you can grow barley after a crop of corn in this way, having, of course dragged your stocks when frozen; manure heavily with green manure, plow as early as possible, make your ground in good order, roll, and drill quite shallow. If you sow by hand, harrow well first, finish with rolling, sow two bushels clear seed. If mixed with oats they will ripen nearly at the same time and will not blow out. It will ripen before your wheat or rye, if sown early. Cut before it is too ripe; house, if possible, without a rain and you will have a fair, bright sample; you can average thirty-five or forty bushels per acre. Winter barley must have the same treatment; will not easily freeze out, and is something heavier. If you sell, as a general rule have your crop ready early. Last autumn you would have got from $1.60 to $1.74 per bushel. If you sell, it will be made into malt; it and cocculus indicus will make beer and bloats. If you feed, grind equal parts with corn; it will make meat, and meat is good for the hungry."

Black Knot in Plum Trees.

Mr. R. Blanchard, of Lyndonville, wrote in relation to a cure for this disease. He said that he discovered it about ten years ago, and had proved its value. "It is this: Take a paint brush, dip it in spirits of turpentine, and thoroughly saturate the knot, being careful not to touch the tree except in the diseased part. It stops the knot, and the tree puts out healthy branches below it. I am careful to burn all the branches removed in pruning. If the spirits of turpentine is applied about the time the flowers open, the curculio will not be so troublesome, as its smell repels insects otherwise attracted by the perfume of the flower. Another remedy I have tried for the curculio, is to smoke the trees with sulphur. On a still evening, when the flowers are opening, place a kettle of coals so that the smoke will circulate freely among the branches, then throw on sulphur and pieces of leather or woollen rags. Of course, care is requisite to prevent heating the branches. A very successful apple grower in our neighborhood smokes his trees in this manner evenings and mornings, every year, to destroy the apple worm. To return to the black knot. As the summer is the time the mischief is done, every

fresh excrescence should be pared off, the turpentine applied, and it will harden in a week."

Adjourned.

March 30, 1869.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

When to Sow Clover.

Mr. J. D. Ackerman, Union City, Mich.—I wish to ask the Farmers' Club if it will do to sow clover about the middle of June with buckwheat, and get a good catch. I have a field I wish to seed; the land is too wet to get in proper condition early enough for oats. Would it do any better with Hungarian grass?

Mr. S. E. Todd.—Somehow all the farmers have got the idea fast in their heads that there is no sowing grass or clover seed without they sow it with some kind of grain. I thought so once, but after a good many years I found out my mistake. Grass does better sowed by itself. But the ground should be well prepared, plowed, cross-plowed, harrowed and bushed till it is as smooth as a garden bed. The time of sowing is not so important as the mode of preparing a seed bed. Perhaps the best time to get clover into wheat or rye, and especially wheat, is early in the spring when the surface is soft with the coming out of the frost.

Mr. W. S. Carpenter.—I have sowed clover as late as the 1st of June, with good results.

Taming the Buffalo.

Mr. V. Devinny, Denver city, Colorado Territory.—I perceive by the reports of the Farmers' Club that the merits of the American buffalo have been lately discussed; the subject having been brought up by a letter from Jessie Felt. Now I wish to say that I fully corroborate the facts of that letter, and consider it both timely and important. It seems that the suggestions of the club were averse to the domestication of the buffalo; one member asserting that "it requires a fence eight feet high to keep them in their fields." This might often be said of the domesticated cattle and sheep. I have seen twenty tame buffaloes confined in a field of poor pasture by a fence four feet high. Mr. Greeley asserts that "the meat tasted like half boiled chips when he eat it on the plains." But as there is a reason for everything under the sun, there may be a cause for the

toughness of that particular buffalo "meat" of which Mr. Greeley partook. It is a fact well known to hunters that when a herd of buffalo are alarmed that the males linger behind and make some show of courage, while the females, with natural instinct, flee with their young, leaving their more brave companions in the rear to receive the fatal bullet from the huntsman's rifle. It is safe to say that five males are killed to one female; were it otherwise, but few buffaloes would now be found on the plains. From the description given we may easily infer the kind of beef tested, the qualities of which have long ago passed into a proverb. I must say, in truth, that under the same circumstances and like treatment, buffalo beef will be as tender as any beef from domesticated cattle. Having lived on the border and in the midst of the buffalo region for ten years, I speak what I know, having no theories to feed my vanity. I have felt annoyed, for truth's sake, that facts would be smothered out by bold theories. I saw a half breed buffalo calf not long ago in Denver which dressed, at five months old, 300 pounds. It had no extra care, and it was the admiration of stockmen, who asserted that common calves could not be made so fat. Why import blooded stock when we have the very best native beef animals? They are more kind than common cattle; they become too tame, with petting, like sheep. I have known them worked in the yoke; yoked with an ox they are unequal, the largest ox is not an equal to a medium buffalo bull. Many are now giving much attention here to the domestication of the buffalo for crossing with common cattle.

Live Fences.

Mr. H. S. Bickford, Grenada, Nemaha county, Kansas.—Can any one of the club give any information with regard to fencing with trees? It appears to me, that trees such as can be easily and surely grown from slips or seeds, if planted eight or ten inches apart, would, in a few years, become a good, serviceable fence, beside making good wind-break, so much needed in prairie countries.

Mr. J. B. Lyman.—On soils where the hemlock grows well, it can be trimmed so as to make a strong fence, and at the same time an excellent wind-break. But the chief difficulty with all live fences is, that they do not receive sufficient cultivation and pruning at the critical time. If neglected, the bush or young tree gets a start upward, and no after treatment will produce that thickening at the bottom so necessary for a trustworthy fence. The osage orange, the

honey locust, the bay berry, and the buckthorn, are the best hedge trees. In the south, where seasons are mild, the Cherokee rose makes a magnificent hedge-fence.

VALUE OF COAL ASHES.

Mr. W. A. Young, Cumberland county, Penn.: Will the club please answer the following questions: I wish to plant potatoes on a piece of new land; it is a stiff blue grass sod and very heavy soil (limestone). Would coal ashes be of any benefit to lighten it? How many one-horse loads to the acre? Will a compost of hen droppings, coal ashes and plaster make a good top-dressing for corn? About what proportion of plaster should be used? I have been greatly benefited by reading the reports of the club.

Mr. S. E. Todd.—What I intend to say is, that coal ashes have so little value as manure, that it would take 1,000 loads to do an acre any good.

Mr. A. S. Fuller.—I can't agree to that. I have found coal ashes, I mean anthracite coal ashes, worth three dollars or four dollars a ton. I like their effect on a sandy soil. As for their chemical value, I don't care what they say, if, by analysis, they find that they contain no potash, no carbonate of lime, no phosphate of lime, nor any other bi-chemical, they have some good effect on my soil, not a great deal, I admit, yet enough to give them a certain value.

Mr. P. T. Quinn.—I use coal ashes at the rate of thirty loads to the acre. I never buy any, but apply all that are produced on the place. It is important to know whether they are ashes of anthracite or bituminous coal. As for the loosing up of heavy clay, I would rather do it by fall plowing than with coal ashes. But I would say a word to Mr. Fuller's shy at chemistry. We know that, when the ammonia and the phosphoric acid are removed from guano, it is worthless. Hence, the inference is altogether fair, that manures containing ammonia and phosphorus are a great deal stronger as manures than such as do not contain them. His proposed compost for corn in the hill, hen droppings with plaster, is excellent. But I suggest the addition of muck or dry garden loam. Hen manure thrown near the seed is stimulating, and its effect will be extended, if earth is well mixed with it. I don't think he will gain anything worth while by mixing coal ashes with it. Muck is much better.

Mr. D. B. Bruen.—I have used the compost nine years on the same land, and always get good corn; better, I think, the last year than

the first. Coal ashes have a mechanical effect, if nothing else; they open and lighten the soil, admitting air and sunlight.

Mr. J. B. Lyman.—I experimented some with coal ashes last year, and my conclusions were not flattering. They give a lush growth of top, but no body to a root, and no grain. I tried them on onions, beets and tomatoes. In May and June they grew bravely, but, as soon as summer heat came on, that part of the garden showed no heart. The onions did not become bigger than butternuts, and the beets were pulled up and eaten as greens, for the roots ceased to grow. Tomato vines grew rank, but fruited badly. My conclusion is, that coal ashes, I am talking of anthracite, may give a spring start to grass, but they are worth nothing at the last of the season, when roots get their size and grain is developed in corn.

Mr. W. S. Carpenter.—In all such experiments we do not know how much kindling wood may have been burned with the coal; the wood gives all, or nearly all, the potash that coal ash contains.

Dr. Lewis Feuchtwanger.—There is much silica in coal ash, and it is, in a fine state, easily soluble in water. This accounts for its effect in spring. But, though the form or outline of plants may be built up from silica, their value for food must come from potassa, phosphorus and lime. Silicic acid is not, properly speaking, an element in true manure, because most soils contain abundance of it.

Bones as a Fertilizer.

Mr. J. M. Paul, North Adams, Mass., would like to know whether it is advisable, where bones can be easily obtained, to attempt a home manufactory of them into fertilizers. If so, what is the best method? Will strong wood ashes dissolve them successfully, and how long will it take? What is the best method of using the whole carcase of sheep, or other animals that die, into fertilizers? Having read in an agricultural paper that a good quality of phosphate of lime can be made by mixing one bushel of salt with one barrel of lime and three of muck, would like to know if any member of the club has tried it? How can I rid my trees of the borer?

Mr. James A. Whitney.—I will say, in brief, that a bone unbroken does about as much good on soils as a stone, and not much more. The best way to get them into the proper state for plant food, is either to grind them fine or to melt them in an acid or strong alkali. Dig a shallow pit, bank it around with clay, break the bones with a big hammer in as little pieces as may be, the finer the better, pile

them in the pit, and pour over them diluted sulphuric acid. Cover them in with dry muck or garden loam. They will soon dissolve. If the weather is warm they will dissolve faster. Crushed bones in hogsheads with strong wood ashes, kept warm and moistened with soap-suds, will soften into mass like jelly, that is soluble in water.

Dr. D. D. Parmalee.—The addition of sulphuric acid by the farmer without reference to proper proportions would be likely to change bones into sulphate of lime, and become a very expensive fertilizer. It would be better to finely pulverize the bones where power is cheap, and let the earth dissolve them, or, to sell the bones outright for thirty to forty dollars a ton, and use the money to buy guano.

Mr. James A. Whitney.—If chemistry has done anything for the farmer, it is in treating bones. The addition of sulphuric acid does not turn bones into plaster, but into superphosphate of lime; thus two great points are gained, the phosphorus is increased, and the whole is converted from a slow, torpid, insoluble mass into a lively, soluble, prompt manure.

Cotton Seed as a Fertilizer.

Mr. I. E. Tate, Osyka, Miss.—The agricultural club of Washington Parish, La., at its last monthly meeting had the following questions under debate, which they desired me, as their corresponding secretary, to transmit to you for decision, or rather for your opinion thereon .

Question 1. When cotton seed is applied as a fertilizer, and it germinates, springing up, is its manurial virtue impaired? And if yea, how much? Please answer in tenths, the latter.

Question 2. Upon an acre of land that will produce (without manure) twenty bushels of corn, what number of bushels may be expected when 300 pounds of good superphosphate of lime is applied?

Permit me to say that our two "ends of the Union" having no longer any sectional cause for disturbance, may ever remain fast friends, indissolubly bound by our common love of country, one common constitution, and one common banner.

Mr. J. B. Lyman.—The American Institute Club reciprocates the expressions of friendship from the distant gulf shore, and is rejoiced to see that the minds of our southern brethern are so much engrossed with the all important question of fertilizers. To the first we answer: The young plant at first grows exclusively at the expense of

the seed. It may be aptly compared to the sucking animal which, when new-born, is incapable of providing its own nourishment, but depends on the milk of its mother. Germination is that change in the seed which fits its contents to feed the young plant. If the plant has reached several inches in height, it has eaten up most of the substance of the seed, and its value as a fertilizer is nearly expended. Partial return of these elements is made by the decay of the little root and stem. If the sprout is killed a few days after it appears, when but two leaves show, it has consumed so little of the substance of the seed that it is still a valuable manure. To the second: You have a right to expect thirty bushels an acre from that land after the superphosphate. If you do not get it, it will be on account of a wretched season, or your superphosphate has been debauched with chalk or ground oyster shells. You may get double, but a third more is the average result of many trials on corn.

Poultry.

The chairman now called upon the committee that had been appointed to visit the New York State Poultry Exhibition last week, to report. Mr. Lyman, one of the committee, gave their report as follows:

Your committee found at the Empire Rink on exhibition by the New York State Poultry Association the largest collection of feathered stock ever shown in this city. In conversation with the owners of these animals, and especially the president and secretary of the society, we gleaned some facts and reached some conclusions that may be of value to the community at large. We do not find that improved blood and fancy combs or gay feathers in chickens makes a decided uniform difference in the value of poultry. Those who show the most satisfactory account current with their poultry yards do not keep fancy fowls. Yet there is no doubt that breeding to a special end or point has accomplished for poultry nearly as much as it has in neat cattle. The chief marks of excellence in a chicken are three; to be a good layer at all seasons, to yield a tender and well flavored flesh, and to fatten rapidly. There is no breed that excels all others in each of these points. Thus, for instance, we have no breed that are in size equal to the Brahmas, in delicacy and fullness of breast equal to the Dorkings, and as egg-producers equal to the Leghorns. To require this would be as hard as to demand of a cow to be as large breed and fleshy as the Durham, to be as copious of milk

on moderate food as the Ayrshire, to give as yellow milkers as an Alderney, and to be as elegant in shape and as bright in color as a full blooded Devon. Such a combination of merits is not to be expected. In choosing among the breeds of fowls one can get at least two good qualities combined, and it is for each person to know and decide for himself for what excellencies he chiefly values poultry. In the white Leghorn he will find a regular and constant egg producer, and the flesh quite good, but a bad mother. They will not set. In the Dorking he will find a fine delicate flesh, a full development of breast, hardiness and self-help, the ability to pick up a living wherever any hen can live. But they are not great layers, especially in cold weather. In the Chinese fowls, especially the Brahmas, light and dark, he finds a big-boned chicken, a rapid grower, a large and indifferent feeder, that bears confinement well and gives more weight of poultry meat to the food consumed than any other. In the French breeds, La Fleche and Houdan, we have a fowl that lays well at all times of the year, and whose flesh is excellent, but they are not inclined to set, and make poor mothers. We recommend to all who keep poultry to improve the common barn-yard chicken by the introduction of cocks of some of the improved varieties. If one wishes to breed mainly for poultry, we recommend a Dorking cock as a consort to Brahma hens. If in eggs there is more profit, let him get a Houdan or a Leghorn cock. The black Spanish is a good layer, but not so remarkable in that respect as the Leghorn. His flesh is usually dry and hard. If he respects flavor and appearance of flesh and fullness of breast, the Dorking blood should predominate. If he raise poultry for market and wishes to sell the greatest number of pounds, and especially if he wishes to convert his eggs into spring chickens in the shortest time, the Brahma fowl will be found most profitable. By thus bringing together the various kinds and affording the public an opportunity to know the characteristics of each, and of hearing how and where they may obtain choice birds, we think the New York State Poultry Association has benefited the community, and the society deserves encouragement and support.

J. B. LYMAN.
A. S. FULLER.
WM. S. CARPENTER.

Mr. D. B. Bruen.—I agree with that report. It is just and sensible. I have never had any great faith in these large bony hens, especially for eggs. Besides they are greedy creatures, and will eat

cabbages as fast as a cow, pretty near. I get my eggs from little, neat Dominique pullets, as trim as a partridge, and speckled like a hawk.

Mr. P. T. Quinn.—The views advanced by the committee are, according to my experience, sound, and can be safely recommended by the club as a summary of what is known about breeds of poultry. Many a poultry book of 150 pages does not contain so much that is really valuable and conclusive as this well considered and condensed report.

Dr. Isaac P. Trimble.—The report is silent on the virtue of the black Hamburg or the penciled Hamburgs.

Mr. P. T. Quinn.—Properly so. The Hamburg is unfit for the table, and, much like the black Spanish, is not hardy. It is a showy chicken, and of some importance for mere fanciers. The mass of the farming community will not find profit in them.

Mr. J. B. Lyman.—I see we have with us to-day, and he is a regular attendant here, Dr. A. Preterre, to whom the gold medal was awarded for the best device for hatching by artificial heat. We would like to hear from him.

Dr. A. Preterre.—My apparatus consists of a small case of drawers, where the eggs are laid on cotton. Under the drawers is a vessel of water, which is kept at the right temperature by a lamp.

Mr. J. B. Lyman.—What is the right temperature?

Dr. A. Preterre.—102 degrees. I have known the mercury to go as high as 105 degrees without mischief, and to fall to ninety-five degrees without spoiling the eggs. I have a little arrangement by which the expansion of a small bar of metal completes the connection, and allows a current of electricity to ring a bell. Its contraction, also, rings a bell. Thus I have an alarm from the incubator the moment the heat is wrong.

Mr. J. B. Lyman.—How many of a dozen can you hatch?

Dr. A. Preterre.—Of good fresh eggs I have hatched every one. Generally there are three or four in a dozen that, for some reason, fail. But I think I can hatch out eight or nine from each of a hundred dozen eggs. Generally it takes three weeks, but some have come out in a little less than twenty days. I shall be pleased to show this device of mine to any member of the club who has the curiosity to look further into the business of artificial hatching, which I find both practicable and profitable.

CURE OF SICK ANIMALS—VALUABLE DIRECTIONS.

Mr. T. B. Willson, Mason city, Iowa.—Concerning the fat cow with fever after calving, give her two ounces of refined saltpeter twice in twelve hours for two days; if the fever does not abate, give her another dose or more, until the fever leaves her; it will do no harm if you give her ten such doses in five days. My mode of giving it is to mix four quarts or more of wheat bran with water, in which the saltpeter has been dissolved; mix to suit her taste as to moisture; the water should be temperate, not over sixty degrees Fahrenheit; if the fever is high, and the cow appears to be in much pain and bowels loose, mix with the mess ten grains of opium, or any preparation of opium dissolved, once a day; card her gently and thoroughly; keep her warm and dry; give her no water colder than forty-five degrees Fahrenheit, but give her all she will drink at that or at fifty degrees. My mode of forcing animals of any kind to drink medicine is to mix the medicine with water, put it in a long-necked bottle, tie the head of the animal high and short, put a clevise in the mouth, put your hand through the clevise, pull the tongue gently through, turn the nose up a little, put the mouth of the bottle back of the clevise, turn it toward the throat, and pour out the contents, and it will find its own way into the stomach.

If you have any of the bovine tribe foundered by eating grain, especially oats, give them all the raw potatoes they will eat; any other roots are good, but not as good as potatoes; cut the potatoes, or they may choke the animal.

If your cow gives bloody milk, as some good ones often do, give alum, the same as saltpeter before-mentioned; and, if mixed with salt in equal quantities, if given in season, will cure the bloody murrain; mix a little laudanum for murrain, and give once an hour until the animal appears easy.

If your cow has caked udder, or garget, as some term it, give saltpeter with salt as above; it has always cured this disorder in a short time for me; the best cows are often ruined by this plague from hot weather and high feed. It is so common that I feel it my duty to divulge this sure cure, if applied in season and faithfully followed out. I don't profess to be a doctor of medicine. I only give my experience; what I state herein I have tried with good success, none having failed with me.

Death of Wm. R. Prince.

The Chairman.—There are on my table two letters from an old attendant of the club; they offer considerable quantities of flower seeds for gratuitous distribution. Beside them, I find this note, with a broad black margin, announcing that the donor of these seeds, Mr. William R. Prince, is dead, and we are invited to attend his funeral at Flushing. So near to us all is the mighty change! So swift comes the messenger that calls us away from these talks of soils and seeds and grasses to render up our body to the earth from which we were taken to the earth that will bloom in flowers above us ages after we have ceased to plant and water them! Few have been more active than Mr. Prince in scattering widely over the land the means for adorning the homes of the people. Now that he sleeps, are not those who never said a word against him glad of that graceful charity? No detraction, and, alas, no praise of ours, can reach him now.

Adjourned.

April 6, 1869.

Mr. Nathan C. Ely, in the chair; Mr. John W. Chambers, Secretary.

Alsike Clover.

Mr. William Jackson, of Westmoreland, Oneida county, N. Y., inquires: "What is the difference between Alsike clover and red clover? Will it make better hay? Will it make better pasture? Will it yield more to the acre? Will it ripen earlier? Can it be cut twice in one season? Will it do better on wet or dry land?"

Mr. S. Edwards Todd.—The Alsike clover, botanically, is the *trifolium hybridum.* The common red clover is known as the *trifolium pretense.* There is probably as much difference between these two varieties as there is between two varieties of Indian corn, or wheat, or oats. The Alsike clover will make a little better hay than the common red; and from all the reports that we have had, it is going to be a very valuable variety, as it is said to stand the cold of winter, and not freeze out so easily as the common red clover. Those farmers who have raised it say it is from ten to thirteen or fourteen days earlier. I do not know as to the pasture, and, indeed, it has not been tested sufficiently as yet to enable us to conclude as to every point whether it will or will not make better pasture than the small kind of red clover. When it is said to be earlier than the red clover, I think that it can only be said that it is earlier than the large

"pea vine" clover. For plowing under it is probably not so good as the large red clover, as the Alsike does not grow so large as the common red.

Home-Made Superphosphate.

Mr. John Crawford, Harlem, Cook county, Ill., writes that, having rented a small farm in the neighborhood of Chicago, and being desirous of using the cheapest and most active fertilizers on garden stuff, he is desirous of making superphosphate from a number of bones in his possession. He has put four pounds of whole bones in a jar, and added two pounds of sulphuric acid for a trial, more than three weeks since, and at the time of writing there was no sign of any change in the condition of the bones. "Now what I want to know," he says, "is, is this the right way, and how long before the superphosphate can be made ready for use? Don't put me off, but give me an answer as soon as possible."

The President.—Here is an inquiry with an entreaty; I hope some one will tell him how to turn his bones into superphosphate. [Laughter.] A few weeks ago a man communicated his manner of crushing bones, in a cheap way. He arranged a large spring pole, like an old-fashioned "baby-jumper," suspended a large stone at the end, and by springing it up and down he was able to crush any large bone, by the expenditure of very little force.

Mr. T. C. Peters.—I think the man makes a great mistake in attempting to grind bones, or to make his own superphosphate. He had better sell his bones for what they will bring, and purchase good superphosphate. There are brands of this fertilizer which are really reliable. Baugh's ammoniated superphosphate is one of the best commercial manures in the market. I have implicit confidence in certain men who make this manure.

Mr. W. S. Carpenter.—It is very difficult to get a mill strong enough to grind bones. No bark mill will crush them.

Mr. H. T. Williams.—I have in my pocket a certificate in which Baugh Brothers, of Philadelphia, told me that if a farmer could buy his own bones at thirty dollars per ton, and apply his sulphuric acid mixed with water, in the proportion of half and half, in an earthen hole, at the end of two days he could have as fine a superphosphate as he could wish for. Mr. J. C. Thompson, of Thompsonville, adopted that very plan, and found no difficulty at all in manufacturing superphosphate for his own use.

Mr. S. Edwards Todd.—I will say a word on the bones. I am no chemist at all; but I know something about the use of bones and sulphuric acid. He may keep his sulphuric acid and bones together for three years, and the bones will still remain bones. The acid must be properly diluted. The amount of water to be mixed with it must be determined by successive experiments on a small scale. When the proper measure of dilution has been obtained, the bones can be dissolved very quickly.

Our chemists, in their lucubrations about bones and the making of phosphate, have overlooked this important point, the proper strength of the acid. When such acid is applied to cast iron to remove the scale, it must be diluted just enough and no more. Pure acid will not take hold and dissolve bones and the rough scales on new plows. When I was on a farm I had a circular mill for grinding corn with which I could grind bones, with one horse to work it. I sold that mill to a man in New Brunswick, New England, and he told me that he has ground thirty tons of bones with that mill. It cost me twenty dollars.

Mr. J. B. Lyman.—On this subject I had a full conversation with Prof Horsford. He was a pupil of Liebig, and in this country he has few if any equals in chemistry as applied to the domestic and useful arts. He advises the farmer to make his own superphosphate, and gives the following minute directions: Get your bones together and break up all the biggest of them with an ax or heavy sledge. Raw bones are much the best, because they contain ammonia in the gelatine. When, by boiling in lye, or by long bleaching, or by burning, the organic matter has been wholly or in part expelled, the bone is still valuable for its phosphate of lime. But a raw or flesh bone properly treated will yield phosphate of ammonia—the most active and valuable of all manures.

Let the farmer dig a shallow pit shaped like a bread-bowl, and if the soil is clay he may make it tight enough by ramming and treading; but if his soil is sandy he should line the pit with a wagon-load of clay. Pile the bones in the pit, and wet them thoroughly with diluted sulphuric acid. Sulphuric acid, or oil of vitriol, will not operate on bones unless water is added. He should buy one-fourth the weight of his bones in sulphuric acid; if he has 400 weight of bones, he should get 100 pounds of oil of vitriol; it costs about three cents a pound. In diluting the acid, more or less water may be used, according as the bones are bleached, or of larger size; but as a rule,

liable to exceptions that will occur to the intelligent farmer, five pints —that is, five pounds—of water should be added to one pound of the oil of vitriol. In a few days the bones thus treated will be found greatly softened, so as to crush under the stroke of a spade. The superphosphate should be mixed with some other fertilizer, as dry muck, and applied in small quantities not directly to the seed.

ANALYSIS OF MUCK, ITS COMPOSITION AND VALUE.

Several specimens of muck from various parts of the country, some from Berlin Heights, Ohio, and a box full of it from John T. Stinson, near Raleigh, North Carolina, have been received by the club, and referred to James A. Whitney, the chemist. The Ohio muck he has carefully analyzed, and describes it in the following report:

"One specimen was taken from near the surface of the deposit, the other from a depth of two feet. The former was of a brown color, coarse in texture, and mingled with pieces of broken wood and fine roots. The other was of a much darker color, finer in composition, and contained lumps of decayed material, which fell to pieces under light blows of the pestle.

The first sample, that from near the surface, contained seven and a fourth per cent of moisture, eighty-four and a half per cent of organic matter, and only eight per cent of mineral matter.

The sample taken from a depth of twenty-four inches, gave eight per cent of moisture, seventy-two per cent of organic matter, and of mineral matter twenty-one and one-fourth per cent, or about three times as much as the first. The sample taken from the greater depth was much more decomposed than the other, and this evidently without the access of air. This had not only caused the relative proportion of mineral matter, potash, silica, &c., to be much in excess of the other, as above indicated, but had produced a change in the structure and condition of the organic matter which would hasten its decay buried in the soil. This would cause the evolution of carbonic acid to be more rapid, which would not only supply, in part, the plants with carbon, but held in solution in water would assist the disintegration and dissolving of mineral particles in the soil. Moreover, this condition of organic matter would greatly increase its power of absorbing and retaining ammonia. The peat, therefore, taken from the greater depth, would be much better for manurial purposes than the surface peat. Neither should be used without admixture with other materials. That from the top of the ground

could be used to the best advantage simply as an absorbent of liquid manure. That from the greater depth, after exposure for a few weeks to the action of air and frost, would be valuable either composted with barn-yard manure or with guano, the refuse of the hen roost, or other ammoniated fertilizing substances.

From the large proportion of organic or vegetable matter contained in both samples, there can be no doubt that if compressed into blocks with suitable machinery, this peat would furnish a fuel valuable where other fuel was scarce, although the disagreeable odor given off while burning would be something of an objection to its use. From indications shown by the material when treated in the crucible, the writer is led to infer that the peat taken from the greater depth could be made available in the manufacture of illuminating gas; and where deposits of this kind exist near towns and villages, it would be well for those whom it may concern to make experiments tending to such results on a practical scale.

We cannot too strongly impress upon farmers the great advantage of composting muck with any rank manure. Use night-soil, hog manure, hen manure, fish guano, and the mutual action of one upon the other will produce a fertilizer greatly superior to muck alone. The organic matter in muck is very similar to the vegetable matter that makes up the bulk of stable manure, and the addition of a little rank matter containing ammonia will change a load of muck to manure as valuable as that which commonly comes from farm-yards.

REPORT ON STUMP MACHINES.

The chairman then read the following report: The chairman of the committee designated to go and see the trial at New Brunswick, N. J., reports that only one of the members of the committee appeared, and only Messrs. Bowen & Brown, of Vineland, N. J., who represent the "Little Giant" were prepared to work. They tried the "Little Giant" on some green oak stumps eight or twelve inches in diameter, which it took out readily by the aid of two men. As a hand stump machine the "Little Giant" is as powerful and cheap as any other hand machine that is now in use.

HOW TO MAKE HOP YEAST.

Mr. Hannum, Kennett Square, Penn., submits the following receipt for making yeast cakes: To a quart of cold water take a good handful of hops; let them boil; then strain; set over fire and pour

in paste of flour and water, a pint of flour at least, and a handful of salt; cook thoroughly; when cool enough add some home-made yeast, and let raise till one perfect foam; then thicken well with corn-meal, and make out into cake immediately. Dry quickly and thoroughly, so the corn-meal will be kept sweet. Care must be taken, if dried near a stove, that it is not too hot, 100 degrees is high enough; ninety degrees will do nicely.

COUNSEL FOR YOUNG MEN.

Mr. John H. Carr, of Ohio, writes: Myself and several others, all mechanics, wish to take Mr. Greeley's advice, and become owners of a small farm, but cannot decide where we had better try to get it; and we write for your advice. I want to know where we can go to make a comfortable living with the least amount of money and labor.

Mr. Alfred Greenleaf.—I am here to-day to get an answer to that question. In Brooklyn I am accosted by men of twenty-five or thirty, married, sober, but unemployed. They want to get to the country but don't know how, or where, or with whom, or what to do. Can I, of this club, get the sound advice for such persons? They say: "We are not afraid to work; we have ordinary intelligence; we are thirty years of age; we have wives and children looking to us for support. We want something to live upon; we can't live upon air, and we don't want, as many in New York do, to live upon other people; now will you, Mr. Greenleaf, tell us where to go to?" I did not know where to come to get the proper answer unless it be to this club, and I come at a good deal of sacrifice to-day to get an answer to that question, which is put to me on all hands not once, but twenty times a week.

Mr. T. C. Peters.—If Mr. Greenleaf will send his friends to me, I will advise them about the south. This country is so broad that a man may go anywhere; but if a man tells me what business he wants to engage in, I will tell him where to go. For cheap farming, the Shenandoah valley is unparalleled, extending all the way along through the State of North Carolina, down through Georgia, and into Alabama. In that region there are nearly five millions of acres of government lands that can be appropriated and settled under the homestead law, and it is as fine a climate as there is in the world, and within short distance of the routes of communication. It is the finest fruit region that I ever saw. It is just about a hundred miles back of the cotton lands. If I was going to advise any one to go down

there I would advise him to go to Atlanta and radiate from thence. That the people of the south not only invite but encourage immigration from the north, is seen from the fact that in January last a convention of southern railways was held in Atlanta, Ga., when the following resolution was adopted:

Resolved, That excursion certificates be issued to parties desiring to visit the south for the purpose of personal observation with a view to personal settlement or investment; said certificate good over all roads agreeing to the same, under such rules and regulations as may be adopted by a standing committee to be appointed by this convention.

Actual settlers on all the roads represented at the convention are charged at the rate of one cent per mile, and excursionists who propose to invest capital or settle are charged at the rate of two cents per mile. E. Hulburt, Atlanta, Ga., is the chairman of the standing committee, who will furnish all the circulars and information that may be desired on application. Everything in this connection is done in good faith, and any man going there will be as well treated as he could be in any other portion of the United States. Now, the people of the south are very anxious to get the north to understand the resources of their country.

Dr. J. V. C. Smith.—I say to such men, especially those who are not familiar with farm industries, go west; get into that wide, fertile, opulent home for the million. If he is industrious, he need not be a day out of work. Where corn is sometimes sold at twenty cents a bushel, he will be very lazy if he does not keep his family in bread. If he knows how to drive a horse, he can get good farm wages. His land will cost him little. No matter if at first his home is a log cabin, nobody there thinks the less of him for it.

Mr. William Lawton.—I don't think the objection so often made, that one does not understand farm work, amounts to much. The best ideas and most important facts about farming can be learned from books and papers. One's neighbors will tell him much the first year. After that his own discretion will guide him. If he can't live at farming he couldn't live at anything, and may as well give it up and go upon the town.

Dr. Isaac P. Trimble.—Whoever takes it upon himself to direct inquiries to any certain part of the country, assumes a weighty responsibility.

Mr. A. S. Fuller.—I want to ask how it is that the fool comes in

fresh from the country and teaches you city people how to do business in the city? The most successful men in the city have been country boys. How do most of the men alluded to here, as successful, manage to meet with such satisfactory success? They do it on other folks' brains; do you wish to teach these young men to work on other folks' brains?

Mr. Wm. Lawton.—The most sensible and most successful men in every community are those who know how to use the brains of other men.

Mr. Adrian Bergen suggested that there was plenty of land on Long Island.

Mr. A. S. Fuller.—The State of New Jersey or New York are just as good a place as any in the world for young men, if they will only live according to their income. I have been in a position to want young men; I am in want of them to-day. I never could get them, decent, intelligent laborers, near the city of New York. A young man will go out with me and stay one summer, and by the time autumn has come he will say, "I rather guess I have learned enough of this business to run this thing myself." They come to work for me, and on Saturday afternoon want to put their kid gloves on and start for New York, and want ten dollars to spend while there. When they go out west they don't expect it. A young man gets married and goes to New Jersey; just as good a place as he can find in the world, to make money. Directly his wife must want a nice carpet and handsome chairs, and they must be had, and it will take $1,000 or $2,000 to do it. Out west a shanty or log-house and a pine table are good enough for the best. They will sit down there and cultivate the land without indulging in any unnecessary luxuries, and in ten or fifteen years they have good farms and a valuable property. That is my experience. I was married in a log cabin, and lived in it, which I never could have done near the city of New York. If it was not for that one thing, the pride of people, I would say to young men, stop in New York; but it is no use. I say, go west; be one of them. Start with the rest and come home with the rest, and then you can come back and live here, and indulge in all the luxuries you want.

Mr. Greenleaf.—There are three thousand young men about the age of thirty, honest and true and energetic, without five dollars to a dozen of them, who would like to know just where they could go and by work and diligence, and observation and labor, and not by

pulling the devil by the tail, as a great many people do here in New York city, secure for themselves a home and a competency. If I put an advertisement in *The World*, "Wanted, directly, a certain number of men," with the guarantee that they should get an honest living, I could get 10,000 in this city within twenty-four hours. Where there are men without money, but with good health, with common intelligence, with a willingness to work, and with the knowledge, perhaps, of some trade, what shall they do, where shall they go; shall they remain here and live on those that are here, or can this club tell them where they can go and have a home for themselves and families.

Seeds from China and Japan.

The president then drew attention to a box of seeds presented to the club by Dr. Wm. W. Sanger, in behalf of his brother, from China and Japan. It was the expressed desire of Mr. Sanger that the seeds be distributed amongst such members of the club as could afford to watch them attentively, and, if required, in cases of successful cultivation, return slips and seed to him. The specimens included the varnish tree, mango, yongtoo, and many other choice varieties of the native plants and flowers of the far east.

Specimens of seedling potatoes of a new variety (one or two of them very large), called respectfully the General Grant, were received from C. P. Butts, Mehorpany, Wyoming county, Pa., which were distributed to a number of the members present.

Adjourned.

April 13, 1869.

Mr. Nathan C. Ely in the chair; Mr. John W. Chambers, Secretary.

Proper Management of a Dry Bog.

John Cowen, of White Plains, Westchester county, has three acres of what he calls dry bog, a low lying piece of land, seldom covered with water, but having a black soil with many tufts of wild grass and stunted bushes. He asks the club how to treat such a surface, and what small fruits will flourish best in it.

Mr. W. S. Carpenter.—I suggest that he drain it, and plow down the tufts or hummocks, then take out the sourness by some alkali, I recommend unleached ashes mixed with fine crushed lime. Such land will then be very valuable for any purpose; and if he would put

some small fruit in such a situation, the strawberry is the best. For a market berry, I recommend Barnes' Mammoth, a large variety, and likely to do well in a fresh, dark soil.

Mr. William Lawton.— Just north of my residence, in New Rochelle, I had a similar field, which I drained and planted out with Wilson strawberries. They flourished and bore very finely. I cannot raise the Triomphe de Grand at all. But we have a variety that we think a great deal of, called the Berdan seedling.

Potash as a Manure.

Mr. James H. Linsley, Northford, Conn., asked: What is the value of muriate of potassa as compared with commercial potash as a manure? Or is the combination such as to decrease its value?

Mr. Jas. A. Whitney thought that the muriate of potassa was not as good as the commercial potash. The chlorine or hydrochloric acid will injure the plants.

The English Sparrow.

Mr. Levi Davis, Ridgeway, N. Y., and others, ask about this bird, whether its general introduction would prove an advantage to fruit growers.

Dr. Isaac P. Trimble.—The English sparrow differs from the bird we call by that name in being larger and more greedy. But he is not an insect-eating bird by nature. He will eat insects when he cannot get seeds, but not all kinds of insects or worms. He is fond of millers, and devours many kinds that are injurious to trees. But the big hairy and tufted worms he does not like. They have been found very effective in ridding our city parks of the measuring worm, but this pest was also assailed by another enemy, a parasite that kills him by the million. Washington square was so infested with worms that the trees were in danger of being ruined, when 2,000 sparrows were let loose upon the enemy. They devoured the worms and millers right and left. The principal merit of the European sparrow is his domestic character. He is very tame, and will live in gardens and close by houses, where the robin and the cuckoo will not venture. As an insect eater the yellow-billed cuckoo is worth a dozen sparrows, for he will eat the most hairy worms and mischievous insects, but he is shy and suspicious in his habits. For my part, Mr. Chairman, I do not think we should displace all our native songsters in favor of a European bird. We have killed and driven away our feathered friends, many

of whom are better protectors of fruit trees than the English sparrow. Our ends can be as well gained by cultivating and protecting the birds we have as by importations.

Mr. D. B. Bruen, Newark, N. J.—I have these sparrows about my place, and I cherish them. They have eaten about two bushels of cracked corn this winter, but Englishmen tell me that in their country they are quite destructive to small fruits, and are specially fond of nipping off the tender buds of cherries. They have proved very useful in this city, because we have shade trees only to defend from worms; but in the country, where fruit and shade trees are blended, and the former are quite as important, it is doubtful whether the sparrow would not do as much harm as good. The robin is a useful bird, and eats our enemies, but the moment we catch him biting a cherry or hovering over a currant bush how quick we blaze at him. The truth is, most of the feathered tribes work us a little ill as well as much good, but the benefit exceeds the harm.

Profit from Hens.

Mr. A. F. Hitchcock, of Erie county, N. Y., wishes to compare his poultry record with the showing made by Mr. Bruen. From eight hens, he took, in a year, twenty-six dollars and eighty-one cents worth of eggs. The estimated cost of their food was ten dollars and eighty-nine cents. Net profit, fifteen dollars and eighty-nine cents, a few cents short of two dollars per hen, no account being made of the value of the droppings as manure. John A. Dickie, of Constance, New York, asks the club why 1,000 hens may not be kept with one hundred times as much profit as from ten.

Dr. J. V. C. Smith.—Some years ago a man in Boston asked himself that question, and took a small island in the harbor to try the poultry business on a broad scale. A thousand hens were bought. He fed liberally, and looked well to their comfort. But presently they began to look shabby, then fell sick and dropped, ate each other's eggs, pulled out each other's feathers, then died by dozens. The poor fellow who made the venture became alarmed, could not pay some debts he had contracted for chicken dough, and finally ran away from the sheriff. I refer to his case, not as a proof, but as a warning that few persons have found profit in poultry when over two or three score are kept in one flock.

Dr. Isaac P. Trimble.—Yet some there are who keep many hundred hens without having diseases. Warren Leland, for instance, at Rye Station, has great success with poultry.

Mr. T. C. Peters.—Let Mr. Dickie get the first number of *The Hearth and Home.* There he will find an excellent article describing Mr. Leland's poultry yards, and all the arts and methods of his success.

Dr. Isaac P. Trimble.—Mr. Lyman has been up there and knows all about the matter. Will he not answer the inquirer?

Mr. J. B. Lyman.—It is true that Warren Leland succeeds in keeping great numbers of hens, turkeys and ducks, without getting diseases among the poultry. He never checks their natural liberty in summer, and in winter makes them entirely comfortable. He has a park or range of seventeen acres, which is given up to the poultry. Then, in summer, the brood hens have another large field by themselves, and the turkeys go where they please.

His poultry keeper is an Englishman, and devotes his whole time to the different yards. The birds are all fed liberally. They lay and set in boxes arranged for their convenience. When a hen comes off, her box is taken to the yard, the straw thrown out, the box left in the sun and rain several days, then carefully whitewashed. The roosts and perches are also whitewashed, and the floors of the houses covered with plaster, to absorb ill odors. In the coldest weather fires are kindled in stoves and fire-places. When the cold moderates these fires go down, and the hens have plenty of dry ashes to wallow in. At all times of the year they get all the food they want, both grain and meat.

He says he can make 1,000 pounds of poultry meat cheaper than 1,000 pounds of beef. No one should think of keeping 100 hens on less than an acre; 1,000 should have at least ten acres. The same roosters never consort with his hens two successive summers.

Dr. J. V. C. Smith.—In tropical regions they raise poultry very extensively. On the Nile, and near Cairo, I have seen large numbers of chickens; they go very extensively into the hatching business. The feed is a sort of grain like broom corn. The poultry is very cheap. But strange to say they cannot raise poultry in Cuba. I know men who export poultry to that island in large numbers. Why they cannot raise poultry there is a problem.

Mr. T. C. Peters.—Is not the atmosphere drier in Nubia than in Havana?

Dr. J. V. C. Smith.—It is the same, I think.

Mr. T. C. Peters.—I see that poultry is raised in Florida with great facility.

Pickling Cucumbers.

Mr. G. H. Barker wrote to inquire the best way of procuring cucumbers for pickles.

Mr. J. B. Lyman.—The raising of cucumbers for pickling is an excellent business; one of my neighbors produced 300 bushels of cucumbers per acre last year, and they were sold to a pickling factory for fifty cents per bushel, when picked about the size of the little finger. The proper manner of preparing cucumbers for market is to pick them when small and of a uniform size, and a great deal depends upon that; not larger than one's thumb, or not much larger than one's little finger is the best. Then they should be put down in salt and a very little water used; there is enough juice comes out to be absorbed by the salt, and this produces a brine. After they have been in the brine until the time for selling comes, they should be taken out and freshened by a succession of waters, and after that they are put into the vinegar, and the better the vinegar the better the pickles. Some use alum to give them a bright color, but if much is used you impart a bad taste to the pickles; but, in fact, it is unnecessary to use alum at all. If you use good, strong cider vinegar, and get all the salt out of it by changing the waters, you get a very good and excellent pickle. I made an experiment in that line myself. I raised from eighteen hills 2,000 cucumbers, filling two barrels, and sold them for eight dollars. These hills covered about two square rods. I hoe my cucumbers over every week, and sometimes once every three days, cutting down the weeds.

Gypsum.

Mr. Wm. Oren Moreau, Hubbardston, Worcester county, Mass., wanted to know where and at what price the gypsum used in the vicinity of Montrose, Pa., is obtained; what is the price per ton pulverized and barreled for transportation; what is the freight to Worcester; what is its comparative value with that obtained from Nova Scotia?

Mr. Wm. S. Carpenter said that there was a kind obtained in the west which is blue, and some think it is preferable to that from Nova Scotia. Both are worth, he thought, about fifteen dollars per ton in the New York market, packed in barrels.

Mr. T. C. Peters.—The Cayuga plaster costs about four dollars at the mill. But Nova Scotia gypsum is thrown upon the wharf

at Boston in thousands of tons, so it would hardly pay to go into Pennsylvania or to come here for it.

In this gentleman's letter was the following cure for

The Blight.

He says: "Where the bark turns black and the leaves yellow I have shaved the bark to the thinnest thickness possible without laying bare the wood over the parts affected; if attended to in season (from the first of June to the tenth of July) you will rarely lose a tree. Pear trees should be closely watched, for if the blight has progressed so far that the leaves are yellow the tree is worthless. Look for the affected parts in pears at or near the surface of the ground; in apple trees, anywhere on the trunk or large limbs, easily ascertained by taking a sharp knife and cutting the bark to, or nearly to, the wood. If the bark is black inside, the quicker it is removed the better for the tree." This was his experience.

Interesting to Bee-keepers.

Mr. Jasper Hazen, Albany N. Y., thus discourses of the superiority of bees who do not swarm: "The following facts, if not entirely ignored, are not duly appreciated by the public. 1. Colonies in small hives, swarmers, give one, two or three swarms annually until the field is so stocked with laborers and consumers as to suffer the loss of many colonies from lack of stores. 2. Every apiarian who has a stock of fifty colonies of swarmers in his field, has 3,000 pounds of honey within their range for their support in addition to the amount they give in surplus. If an average of twenty pounds surplus is given, he has 4,000 pounds. 3. Fifty colonies, giving 1,000 pounds of surplus, consume three-fourths of the product of the field, and the keeper secures one-fourth. 4. An apiary that gives an average of but ten pounds surplus consumes six-sevenths of the product and gives but one-seventh to the keeper. 5. Colonies averaging thirty pounds surplus consume two-thirds of the product and give one-third to their keeper. 6. Colonies averaging sixty pounds surplus consume one-half and give one-half to the keeper. 7. Colonies giving 120 pounds surplus consume one-third and give two-thirds to the keeper. 8. Colonies giving one hundred and eighty pounds of surplus consume one-fourth of the product, and give three-fourths to the keeper. 9. It is less expense and trouble to provide and take care of one colony that will give the keeper one hundred and eighty pounds of surplus

than of eighteen colonies that will give ten pounds each. 10. It would be cheaper and easier to raise 18,000 pounds, nine tons, in the large hives, than 1,800 pounds, less than one ton, in the small hives. My experiments give the largest surplus lacking six pounds in one class of hives, and less than ten pounds in the other class.

Will bee-keepers and the public be satisfied with 1,800 pounds of surplus when they may have 18,000, for sale and for use. I make my estimate from facts in experiment. There is margin left to divide the large surplus and double the smaller, and yet have them stand ninety to twenty. And divide and double again, and the large hive still gives the most surplus by five pounds.

SUGAR AND SUGAR SAND.

Mr. M. Van Winkle, of Oneida, Eaton county, Mich., asks what makes sugar sand, a deposit from maple syrup:

Mr. J. B. Lyman.—Prof. S. W. Johnson of Yale scientific school says: "The 'sugar sand' consists essentially of *malate of lime*, a compound of lime with the acid of sour apples. Malic acid appears to be a normal ingredient of the juice of the maple, though commonly existing in it to only a very slight extent. What causes influence its formation, and its greater abundance at one time than another, are not known, so far as I am informed. Precise facts are wanted as to the conditions and circumstances of its appearance or non-appearance. Such facts do not appear to have been put on record. My personal observations of maple sugar making extend over a period of ten years or so, and were obtained in Lewis county, New York. I never there saw 'sugar sand,' and, in fact, never heard of its occurrence in that region. I did, however, notice a slight incrustation on the pans in which the sap was boiled down to syrup, and remember that the 'settlings' of the syrup, especially toward the close of the sugar season, were sometimes gritty. This incrustation was thought to be lime, and both it and a portion of the sediment from the syrup were doubtless malate of lime. Malic acid forms with lime, as with most other bases, two distinct salts. One of these, commonly designated the acid malate, is freely soluble in water; the other, or neutral malate, is very sparingly soluble. The latter it is which crystallizes from the sap during concentration and forms the sugar sand. It would be interesting to hear from Mr. Van Winkle at what stage of the process of sugar-making the sugar sand separates, what quantities of it appear, what the soil of his maple grove is, and other particulars

of special interest, would be a statement of the points in which the weather of last year differed from that of present year during the sugar season. I should be glad to obtain samples of the sugar sand." Thus called upon by one of the leading men of science, Mr. Van Winkle and his neighbors will confer a favor by forwarding to the club specimens of sand sugar and facts relating to its appearance or disappearance, that Prof. Johnson may have the means of studying the subject to the bottom.

When to sow Plaster.

Mr. A. C. Frost, Olivet, Mich.—May I add a word about my experience with plaster of paris as a fertilizer? I have used it only three years, and have acted upon the principle that it does not "furnish food immediately to the plant," but that it "absorbs the gases of the atmosphere in a wet state, and gives them out, to nourish the plant, in a dry state." Accordingly I have always sown it before vegetation started; twice on the snow the last of March. My soil is clay, clay loam, and some portions considerably sandy. My fields are noted here, on account of *early* and good growth of clover, and none "hold their own" better in this respect during the late summer and fall. I have a neighbor who practices the system of sowing his plaster on the partially grown plant, but with results, as I observe, decidedly in my favor. I think the early sown gets the benefit of the frequent early rains to dissolve it, while the late sown, often fails to confer its benefits, for the want of their dissolving effects. I sow a half bushel to the acre each year. I am glad to see this subject discussed by the club. I am far from being "set in my way" of using this article.

The Best Absorbent.

Mr. W. E. Clarke, referring to the discussion on the use of ashes, says: "As Mr. Holden seems to ask his question about the value of dry earth as an absorbent of all foul gases in some astonishment and doubt, I would say to him, that, fifteen or more years ago, Prof. Way, the chemist of the British Agricultural Society, after extensive and expensive experiments with plaster, charcoal and charred peat as an absorbent and deodorizer, accidentally stumbled upon the fact that common garden soil was as good, if not better, than either, and the professor and everybody else were as much astonished at the discovery as Mr. Holden seems to be, notwithstanding that the principle was in constant operation all around them, and had been from the

beginning, preserving the earth from utter corruption, and continuing and increasing its fertility; and that the compost heap was the result of the observation and experience of the practical tillers of the soil in all ages. In answer to Mr. Wilbur, let me say that wood ashes should never be applied to hen or any other manure, as they expel, instead of absorbing, the ammonia. Coal ashes, on the contrary, contain but little alkali and a large amount of alumina, which absorbs the ammonia and retains it until drawn out and appropriated by the roots of plants. Mr. Carpenter is all right in putting unleached wood ashes in his hens' nests. He should also rub a little oil of any kind not corrosive under the wings and around the thighs and heads of his fowls. These will prevent lice; and, if they have become lousy, open their feathers and rub them with the ashes a few times, and then apply the oil. He will find it effectual.

Adjourned.

April 20, 1869.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

NEW CROPS FOR SOUTHERN CLIMATES.

Mr. J. W. Gregory having returned from a tour in the southwest, said the chief object of his visit was to introduce to the southern farmers the castor bean, and the new textile plant, Ramie.

THE CASTOR BEAN PLANT

Requires a rich, strong soil, and reaches the height of a tree when not kept down by topping. It will flourish best on the black prairie lands of Texas, and the rich alluvions of Louisiana and Alabama. It is ornamental as well as useful, and will grow as a garden plant as far north as forty degrees, but cannot be cultivated as a crop with much profit north of thirty degrees.

The bean is not affected by drouth or worm, while its culture is well suited to the present scarcity of labor, especially as in the perennial form it will, as in India, produce five or six crops without replanting. It should be planted in rich ground, early in March, deeply covered; the ground checked off as for corn, eight feet between the rows, six feet between the plants in a row. Plant two beans in a hill, cover, and work between, as for corn. When the plants are a foot high, thin out to one plant; pinch off the top of that, and if the tendency is to grow rank, repeat the pinching on the end of each

branch when the plant is three feet high; and again the same when it is five feet high, as the blossom or spike usually grows out of the fork of the branches.

For uplands six feet each way will usually give room enough. This checking will make about 1,200 plants to the acre, requiring some two and a half pounds of seed. These 1,200 plants, it is believed, will yield about two and a half pounds each of clean seed, which at the rate of three cents per pound, specie, would realize the handsome sum of eighty-one dollars per acre. This result, however, requires not only the large perennial seed (the only sort that should be planted), but good ground, well worked, and a shelter to throw the spikes under as fast as gathered. The greatest losses in Texas have been caused by want of the large perennial seed, and resorting to the small annual bean. Fine results have been attained in Texas by merely putting in a few seeds to make shade for poultry, and as an ornament, without any cultivation whatever.

Profitable experiments can be made by raising one plant in each angle of the rail fences of cotton fields. This will also help to protect the cotton against all destructive insects, including the cotton worm. It may also be found valuable to alternate cotton and the bean through large fields, planting every third, fourth, or sixth row with the bean.

THE RAMIE.

Mr. Gregory has brought north a package of the roots of this plant, and will soon present before the club specimens growing in pots or boxes. At the late State fair of Louisiana a prize was awarded to a grower who entered two bales of this material. When growing it looks, he says, like young white willow; the stalks are round and tapering. As soon in the season as these shoots begin to change their color slightly, they may be cut even with the ground, when another vigorous growth follows. In a long season a third crop will grow, and may be harvested. The Ramie has a long, fine fiber, in appearance half way between silk and cotton. It is the fiber of the wood, not the bark, and is separated by a process not unlike the dressing of flax. From one-fourth to one-third of the weight of the stalk consists of the fiber. After the woody parts are removed the fiber is dipped in an alkaline solution. In this way the soft parts are all eaten away, and little but the white threads remain. Ramie sells now in London at from fifty to sixty cents a pound. At present it is used to mix with silk as it has the requisite fineness and gloss. All

silk spinners and weavers are glad to get it, and would use much more of it. The produce of an acre on good land is about 500 pounds at a cutting, or 1,500 pounds in the season. It produces three times as much as cotton and sells for twice as much. Three or four plants will afford root-cuttings enough to plant an acre. The chief difficulty at present, Mr. Gregory thinks, is the want of a good and cheap process for clearing the fiber. He suggests that perhaps roasting in a box with superheated steam might break down the texture of the stalk, yet not damage the staple. There is room here for another Eli Whitney to present the south an invention that will do them as much for Ramie as the gin did for the cotton plant.

Family Cheese.

Mrs. H. L. Hill, Albion, Ind.—Thousands of families, with two or three cows, would like to make a hundred or more pounds of cheese for home eating, if they knew just how. I will tell my experience. Three cows are quite enough for making cheese for a small family. Two good cows will do very well. A hoop, either of wood or tin, is necessary; about seventeen inches in circumference, and seven or eight inches depth, is about the size needed. A yard of thin, coarse muslin is also needed for a strainer. The directions given for making cheese on a large scale should be followed as near as conveniences will allow. A tin or copper boiler will do to set the milk in, though a cheese box, with a hole near the bottom, stopped with a plug, for drawing off the whey, is used by some, and considered more convenient. I use the boiler, and like it best. The milk should be set in pans over night, put in the boiler and warmed in the morning; when morning's milk is added, and it is ready for the rennet, it should be just blood warm; if too cool, the curd will be tender, or, in other words, the white whey will come out. No directions can be given as to the quantity of rennet, as it varies in strength; the curd should come in half or three-quarters of an hour; if it comes too soon, put in less rennet next time. When the curd shows whey on the top by pressing the finger on it, cut it with a knife both ways; in half an hour slip the whey, if in a boiler; if in a box, drain it by the strainer on top of the curd in dipping. Pour hot water on the curd, after the whey is off, till sufficiently scalded, which is known by taking a handful, pressing it slightly, and tossing in the air; if it adheres together it is sufficient. I had forgotten to mention that before scalding, the curd should be cut as fine as possible with a milk skimmer;

this is important. After scalding, drain thoroughly; I put mine in the strainer, and hang it or lay it on a cheese rack, then wrap in a dry cloth and put in the coolest place you have till the next day; I put mine in a pail and hang it in the well. The next morning when the new curd is drained put the old curd in some warm whey for a short time. When the new curd is ready for the press, cut both old and new in small pieces and salt sufficiently, if too much salt is used the cheese will be hard and crumbly, if too little, the cheese will not cure good. The curd is now ready for the press; after pressing, and here it should be taken from hoop and turned, and a dry cloth put over it and put to press again; at night it should be again turned and a bandage sewed round it; I put no cloth at top or bottom. Let the cheese remain in the press till morning, then grease it with very salt butter or lard; some use grease that red peppers have been steeped in, and think cheese-flies are not as troublesome. Almost anything will do for a cheese press. As good cheese as ever I eat was pressed on a block under a board, with one end placed between the logs of an old house and stones laid on the other end. My press is a common bench with two upright pieces at each end and a lever passing between them, fastened with a pin at one end, and weights hung on the other end. If any lady needs more particular directions I will cheerfully give them.

A New Potato.

Mr. Rufus Potter of Oswego Village, N. Y., sends a package of fine, large tubers, which are little known out of this village. He calls them the "Pride of Dutchess." The specimens were of the size of a goose egg and tapering like an egg, white, smooth, regular in shape, the eyes not depressed, and the little sprouts looking vigorous. He says it yields no small potatoes, not enough to require sorting at all. The tuber grows close to the stalk, so that digging is easy and harvesting rapid and pleasant. For the table he thinks it equal to any.

The Dongan Apple.

Mr. Pierre C. Van Wyck, from the assessor's office, fourth district of New York, sent for distribution a number of the Governor Dongan apple grafts. In his letter he says: "This apple, I don't hesitate to declare, is the finest sweet apple I have ever met, certainly much superior in delicacy and other qualities to the 'Ladies'

Sweeting,' or other sweet apples described in Mr. Downing's work on trees. The apple is a little inferior in size to the largest Newtown Pippin. It keeps about as well, perhaps better. Have had them at grafting time; is a very great bearer. The original tree was brought to this country by Governor Dongan and planted at Canton, in the manor of Van Cortlandt. The tree from which the grafts were cut stands on the place of Philip G. Van Wyck, Esq., at Sing Sing, and is a grafting from a graft from the original tree. This apple is as crisp as the Newtown Pippin or the Little Ladies' apple. I commend the variety as worthy of culture by all lovers of fine apples."

Mr. Carpenter, Mr. Fuller, and others, will graft them and report to the club when the cions come in bearing.

Williamson's Whiffle-tree.

This whiffle-tree has a curved bar, has a clevis at the center, which is fitted with a pulley and chain working through it. The outer traces are hitched to the ends of the curved bar; the inner traces to this chain, which plays on the pulley. It distributes the strain, makes the draft even, and stops chafing.

Mr. A. S. Fuller.—I have tried his implement on my farm, and can recommend it.

Churn Dash.

Mr. Howard Tilden exhibited a churn dash at the last meeting, and claimed that it was a new and valuable invention. In order to show that the invention is not a new device, Dr. A. Preterre, No. 159 Bowery, the inventor of the eccaleo beon, brought in a small churn exactly like the one exhibited as new. The doctor came to this country in 1858, and brought this little churn with him, which bears the French stamp. He stated that the emperor was so well pleased with this churn that he ordered a supply of butter made every morning for his table in a churn of this style.

The effect of such an array of incontrovertible evidence is in favor of the priority of the French invention.

Cut or Uncut Hay.

Messrs. Herenden & Jones, Geneva, N. Y., say that they had experimented with cut or uncut hay for horses, and it pays to cut hay; then to wet and mix the other food with it. This not only saves the horse the trouble of chewing, but concentrated food is mixed through the hay, and the stomach better digests it, and the animal gets all the substance out of it.

Adjourned.

April 27, 1869.

Mr. NATHAN C. ELY in the chair; Mr. JOHN W. CHAMBERS, Secretary.

DEEP VERSUS SHALLOW PLOWING.

The president read a letter from Mr. W. J. Pettee, Lakeville, Conn., upon this subject as follows:

In the discussions of your Farmers' Club I notice quite a discrepancy of opinion in regard to the subject of deep plowing. I look upon this as a topic upon which no universal or invariable rule can be given, but which must depend wholly upon contingent circumstances, as, for instance, the nature of the soil, kind of crop to be put in, and something which can only be positively determined by repeated and carefully noted trials. When Mr. Greeley tells us he has received great advantage in plowing or trenching certain soils on his Chapuqua farm some fifteen to twenty inches, he may not be fully warranted in enforcing the idea that all soils should be stirred to the same depth uniformly.

But some general rules may, perhaps, be given regarding this disputed topic. For instance, heavy soils should be plowed deeper than lighter; more shallow plowing for corn than for clover, and wheat, or rye; especially does clover need a deep soil, its rootlets extending to a great depth. Reference should also be had to the nature of the subsoil; that which is wholly made up of clay should be disturbed but slightly. A proper way for a farmer to determine what is correct as to his own soil, is to plow a field at different depths, noting carefully the effects on the ensuing crop. This is, we think, one of the many themes in agriculture where practice is much to be preferred to theorizing.

LANDS IN VIRGINIA.

Chairman.—We have with us to-day a gentleman well known in the country, and especially familiar with the various parts of the old dominion. He is, I believe, in some sort a representative of that great and ancient commonwealth. I take pleasure in presenting to the club, Gen. Imboden, of Richmond, Virginia.

ADDRESS BY GEN. IMBODEN.

In appearing before a northern agricultural society, and urging the claims of my State upon all who are looking for cheap lands, I am aware that I encounter in many minds a preconception that is not

favorable. Virginia calls up to the northern mind the image of a wide region, once smiling and fertile, but now practically a waste, exhausted by a bad system of tillage, and of late scorched by the desolation of a fierce civil strife. But this, gentlemen, describes but a small portion of that great commonwealth. My home was originally in the Shenandoah valley, and I am personally familiar not only with that fertile district, but with every corner and region of Virgina, except two or three counties near Chesapeake bay, and I believe that to-day my State offers greater facilities, more inducement and opportunities to farmers of every class and all tastes than any State of the republic. There are large portions of Virginia which, though the oldest, are in some respects the newest and least understood. I refer now to the southeastern counties, those having Norfolk, Petersburg, Williamsburg and Richmond as the nearest market towns. For the average northern farmer of limited means, accustomed to garden tillage, I especially recommend the country between the York and the James, east of the Chickahominy, the very territory that seven years, five and four years ago this spring had fixed upon it the eyes of two continents as the scene of such extraordinary military operations. The soil of the peninsula is light, mellow and kindly. Vegetables of all kinds flourish well, and all the small fruits give profit. Beneath the surface there are great beds of marl, and the swamps afford abundance of muck. The climate is mild, the winters open, the springs early, and the farms within easy communication by water with great cities and an immense consuming population. Near the rivers the average price is about ten dollars, but not over fifteen dollars an acre. A little back, on high and healthful ground, lands can be had at from five dollars to ten dollars, the average being perhaps about eight dollars. In what we call the Piedmont counties, beginning with Loudon near the Potomac and going southward through Fauquier, Culpepper, Madison, Orange, Green, Albermarle, Louisa, Nelson, Amherst, to Appomattox and the tier just east of these, the price of lands is a little higher, being about fifteen dollars. These lands are well adapted to regular field agriculture, a rotation of clover, wheat, corn, tobacco. This region was little wasted by the war, and in point of beauty and healthfulness is not surpassed on the continent. West of these, beyond the Blue Ridge, lies the Shenandoah valley. This, properly speaking, does not extend south of Staunton. But in fact a depression of the surface continues on till it sinks into the valley of the Tennessee. In these southwestern counties, Montgomery,

Pulaski, Wythe, and Smythe are the finest grazing lands. Grass is spontaneous. Millions of acres now in forest can be converted into pasture by girdling the forest trees and scattering a few pounds per acre of herd grass and timothy seed. Most of our prize cattle come from these rich valleys and fertile hillsides. Here, too, are vast deposits of gypsum and extensive salt works. Here lands can be obtained at moderate prices. In the Shenandoah valley the best farms have not declined in value, and some are worth more than before the war. But the immigrant cannot go amiss of land in Virginia. There are in the State 44,000,000 acres, of which only 11,000,000 have been plowed. Of the remaining 33,000,000, five or six millions are too rough and steep to be of agricultural value. But I am safe in saying that Virginia can offer you the pick of 25,000,000 acres at prices low enough to be within the aspiration of every working, saving man. For the regular wheat growing and stall feeding farmer, there is as good a chance as in any State east or west. May I not say to the man whose letter of inquiry was read that he can fatten bullocks as fast and with less expense, and get them to a good market with as moderate loss, as in any region he may pick. In wheat, Virginia has a clear advantage, on account of the dryness of our grain. We can produce a flour that will bear transporting twice across the tropic zone. The great mills of Richmond have always given more for Virginia wheat and obtained better prices for their flour. There Mr. Rice or any other settler will be within eighteen hours of this city, and can communicate easily and daily with his friends, and with the best of markets. Let me add a word with regard to the way in which a northern man is looked upon. I know of but one man in all Virginia who in his heart wishes to see slavery re-established. True, emancipation was a terrific blow to private fortunes. In an hour 10,000 families were reduced from opulence to penury. We are of course saddened and in some cases soured by such reverses. But we felt before the war that slave labor was unthrifty and profitless. Now we are all of us deeply convinced that with the blasting of our special form of civilization, we are to adopt the chief features of that civilization that has grown up alongside of ours, and in the late contest came off winner. We fought for an idea. Some of us still think that idea was not wholly an error. But we call it a defeated idea, an exploded doctrine, a thing of the past, and we say, let the dead past bury the dead. Hence we welcome among us the northern farmer. We

consider him our friend, and from him is to come the renovation of our surface and the revival of our social prosperity. Of course we are at first a little cautious. We wish to know whether a man is what he claims to be, and whether he will quietly till the land he settles on. When satisfied of that, the Virginian is prepared to give him a hearty welcome. Looking at migration practically, I do not advise the farmer with a few hundred dollars to come alone and single-handed. Let five or six combine, and pay the expenses of a careful observer who is to visit the parts I have described. Upon his return he can consult with the friends he represents, and they can all buy and move in company. I shall be glad to give such colonies all the aid I can by letters and by traveling directions, so they can obtain the most valuable knowledge at the lowest cost. As to the negro question, the older ones will work very well at twelve and fifteen dollars a month. But the young blacks are idle, and yearly becoming more so. White labor is steadily displacing them, and they drift southward into rich but malarious districts. To the suffrage question I attach little importance. Ten years hence machines managed by white hands will till our soil, and harvest all our most important crops, and the votes of white men will elect our magistrates. The negro is, at least in one vital point, below the white, the power of forecasting, and the skill necessary for shaping a policy for the future. There is room and home, a happy civilization, and a sunny future for 300,000 families within the borders of that broad republic, and Virginia stands ready with open and kindly arms to welcome this great army of peaceful and industrious invaders.

The chairman, taking him by the hand, said: I want to tender to you the thanks of the club for the sincere and candid manner in which you have spoken. I welcome you, or any other Virginian, to our meetings.

General Imboden.—I beg also to extend to every one of you the hospitalities of my humble home, should you ever come to Richmond.

Dr. J. V. C. Smith then moved a vote of thanks to General Imboden, for the lucid statements and the information they had heard.

Mr. T. C. Peters seconded the motion, saying that the general had left out many good things which he might have said of the State, for he had traveled there considerably, and could speak further of the capabilities of that country.

Dr. Isaac P. Trimble said that he had always opposed emigration to the south, but this gentleman had put so entirely a new phase on the matter that he should withdraw all opposition in future.

General Imboden.—I pledge you my honor, or, if need be, my life, that any northern man in any county in any part of Virginia will feel as safe as he does here, and that he will be exempt not only from violence, but from anything that will wound his feelings. The motion was then put and carried unanimously.

RED SPIDER (ACARIUS TELARIUS).

Miss E. A. Drake, Hamilton Corners, Medina county, Ohio, sends the following recipe for removing these pests from, and not injuring, plants: "After ten years' experience, we find our simple method a very good one. We take lukewarm water and make a light suds with Castile soap, and with a syringe give them a very thorough washing, being particular to wash the under side of the leaf (as that is the hiding place of the spider), and then with clean water rinse the most tender plants, but the more hardy will seem to thrive well after a thorough sudsing, without rinsing; but do not expose them to the hot sun in less than twelve hours. Three or four washings will keep the plants free of all insects for the year. If any one has a better way of keeping plants, we should be glad to hear from them. Resetting of plants should be done in April or early in May, as the plants are just waking from their winter's nap, and when they begin to stretch themselves and laugh, they should not be disturbed, as it will stunt them for the rest of the season."

A REPORT AGAINST BUTTER POWDER.

A committee, consisting of Messrs. Joseph B. Lyman, James A. Whitney, and A. S. Fuller, having been appointed to consider the matter of a certain butter powder presented to the club at their last meeting, presented the following report:

The undersigned, of a committee appointed at a previous meeting to investigate the so-called butter powders sold by parties in Vesey street, in this city, would report as follows:

The boxes of the powder are labeled "Star Butter Powder, directions: To one quart of milk about twelve hours old, add one pound butter, warm by setting the churn in blood-warm water, add one teaspoonful powder, churn as usual, and you will have two and one-half pounds delicious fresh butter, cool with ice or water, and work only enough to salt to taste; keep in cool place."

The undersigned went to the place above indicated, and witnessed the method of using the powder. A quantity, perhaps a pound, of

butter was placed in a small tin churn with about a quart of milk and a teaspoonful of the powder added. It was then churned for about fifteen minutes, some coloring matter, the exact nature of which was not ascertained, was poured in, and the churning continued for a few minutes longer. Whereupon the whole was turned out into a wooden bowl. The milk had apparently been deprived of its buttery and cheesy matter, and the butter from a bright yellow had been brought to a dirty white color. A box of the powder was obtained and subjected to a careful analysis to determine its composition. It consists for the most part of burnt alum with traces of sesqui-oxyde of iron, and carbonate and phosphate of ammonia which were simply impurities in the alum. The remainder, a considerable portion of the powder was free tartaric acid. A pound of butter is simply sixteen ounces, a teaspoonful of the powder would weigh perhaps half an ounce, and one ounce and a half would be a liberal estimate of the solid matter in a quart of milk. This would give at the outside a total weight of eighteen ounces instead of the two pounds and a half promised by the venders of the powder. Anything more than this must be gained by the water incorporated in the butter by the churning to which it is subjected, and this explains why the purchaser is directed to work the butter only enough to salt to the taste. Attention is, furthermore, called to the fact that alum is one of the most deleterious substances used in the adulteration of food, and its use in connection with the latter cannot be too strongly reprobated. To sum up, in a few words, we would say that the "Star Butter Powder" is simply one of the most transparent swindles that have ever been brought to our notice.

On motion of Dr. Trimble the above report was unanimously adopted.

Cure Scab in Sheep.

Mr. John Palmer, of Platt county, Ill., sent the following for this purpose: "Take tobacco; boil until strong; then add soft soap and salt; then, for 100 head of sheep, add one ounce of carbolic acid, crystalized, as it is the best dip, and rub the affected part well. The soap softens the part and creates a gum, while the *salt* tends to allay the *itch*. Tobacco will not cure by itself; we tried the pure tobacco and failed to cure; then we mixed this dip ourselves. We used this dip the last year and have now got our sheep about; another dipping will cure them. Be careful to get the hard scab soaked well,

and if possible remove from the old pens into new ones after dipping and a cure will be sure."

AGRICULTURE IN GEORGIA.

Mr. J. Howard Brown, Augusta, Ga.—In a tour of several weeks through the southern States, I have had opportunities of judging of the present tone of sentiment of the southern people, and especially as regards the encouragement of northern emigration, and their feelings toward those who wish to make the south their home. The universally expressed opinion among all classes is that their only hope of future prosperity lies in the enterprise and superior training of northern farmers as superior to and soon to supplant their slovenly and imperfect system of planting. Seeing this, and that there is no other way of obtaining the practical knowledge requisite to change the prevailing sentiment that cotton is the only crop adapted to the cotton States, is the importation of more such men as the few now so successfully farming the lands of South Carolina and Georgia, opening the eyes of accomplished planters and wonder-stricken negroes at one and a half, two and two and a half bales of cotton to the acre on a clover sod, preceded by corn, and followed by wheat, and then a crop of genuine North river hay that is cut three several times, and nets from thirty dollars to forty dollars per ton at the nearest depot. In view of these facts, and the apparent ease with which they are produced, the former exclusively cotton planters are on all hands praying for more northern men to come and teach them how to become farmers rather than planters. The land is cheap. You can purchase improved farms, with all the necessities of life and many luxuries, for from two dollars and fifty cents to ten dollars per acre, near cities and depots and markets ready and glad to have all you can raise. If you have but little money, they will sell you the land and wait for the money until you make it from the fruits of your toil. Pay a little down, and they will depend on your success for the balance. Have you no money, and are you a practical farmer, go to Dr. Jaynes, near Penfield, in Green county, and he will give you a farm, furnish you with teams and provisions, accommodate you with a house, and let you pay for your farm from the proceeds of your labor. This plantation is one of the best in central Georgia, and where you can raise from twenty to forty bushels of wheat, three-fourths to one and one-half bales of cotton, thirty to sixty bushels of corn, and three tons of North river hay to

the acre. He is a progressive man, and expects to learn much from those he so liberally offers to assist. He can accommodate from fifteen to twenty families, and all he wants is the enterprising, industrious, and thoroughly alive northern man to come, and he will do by him as many a father here fails to do by a son, give him such a start on the highway to success that ordinary industry, with perseverance, will insure him that success. It will cost you fifteen dollars to get to Charleston by steamer, and from there to the place you may travel for one cent per mile, or one dollar and sixty cents; so the poorest may embrace this opportunity. There are many others in Georgia that will do as well; only let your wants and wishes be known, and a kind-hearted and generous people will invite and urge you to share with them the health-giving climate of central Georgia, where consumption and all pulmonary and scrofulous diseases are unknown, and where a genial climate and fertile soil will reward your labor by bountiful harvests and well filled barns.

Profit from Poultry.

J. W. Todd, Vermillion, Ohio.—Am on a farm and keep fowls for pleasure and profit. I commenced January 1, 1868, to keep a daily account with fifty-six hens and four cocks, which foots up for the year as follows:

615 dozen eggs, at 29 cents per dozen	$178 35
Cost of feed	30 00
Net profit on eggs	$148 35
From the same hens I also raised 198 chickens, which amounted to	$180 95
And cost in full	80 00
Cleared in chickens	$100 95
Added to amount of eggs	148 35
Total net profits	$249 30
January 1, 1869, commenced with 80 hens, which have produced eggs as follows: In January, 120 dozen; February, 127 dozen; March, 141 dozen; April 20, 92 dozen, or a total of 480 dozen in 110 days, at 25 cents per dozen, amounting to	$120 00
Cost of feed during said time	20 00
Leaving net profit of	$100 00

I am no dealer in fancy poultry, but keep fowls for what they can produce. For me the breed that returns the largest for the outlay is the most profitable, as it costs no more to keep good stock than poor, and I am not so biased in favor of any breed that I would not change for a better one. For years I have tried barn-door, graded improved fowls, but the above result may be accredited to White Leghorns for constant layers, and Bramas for market and winter laying. My experience proves that there is much in feed as well as breed, and I give my fowls the best of care in winter, feeding plenty of grain, meat, and vegetables, with broken bones and shells, and a supply of fresh water, dividing them in two or three lots, and housing in warm, roomy buildings. In summer they have the range of fields and orchards, and require little or no feeding. If there are any common fowls that can do better in producing eggs than my Leghorns have done, you will do us farmers a great kindness by telling us where they can be found, for we want to feed none but the best paying hens, and have all tried what we supposed were genuine "dung hills," and found them wanting, in not laying above 120 to 140 eggs per year, too good setters and non-winter layers, in fact no better for eggs than Bramas.

ARTIFICIAL FERTILIZERS, THEIR MANUFACTURE AND USES.

Prof. James A. Whitney read the following paper:

The subject is somewhat mal-odorous. The material from which a large proportion of this class of fertilizers are fabricated is organic matter in various stages of decay, and would repel rather than interest were it not for the collossal proportions which the manufacture of manurial agents have of late years assumed, and the direct bearing which it has upon agricultural progress in many portions of our country. As it is, few topics are of greater practical importance to the farming community.

The object of all manuring is simply to supply the soil with those elements which are capable of being taken up by plants and by the mysterious agency of organic life transmuted into stem, leaf and kernel. There are in all about a dozen of these elements, some required only in small quanties, while others must exist in larger proportions, these last being ammonia, phosphoric acid and potash. Of these the two former are those for which artificially prepared fertilizers are the most highly prized, although the potash contained in many varieties adds materially to

their value. The worth of any manure, artificial or otherwise, is, of course, in the direct ratio of the available amounts of these substances it contains. It is not enough that these should exist in the manure, but they must be, as just indicated, available; in other words, they must be in such condition as to be readily dissolved in the soil, so that they may feed the tiny rootlets that permeate it in all directions. Here lies a great difference in artificial fertilizers, especially in these valued for their phosphate acid. For instance, a bone is a phosphate, and so is a chunk of Navassa guano; but in order to convert the bone into a prompt manure, it is only necessary to crush it to powder, while the Navassa product, treated in the same manner, without being prepared with acid, would yield only very slight results. This question of the solubility of the substances does not, of course, relate to ammonia, which, being a volatile gas, is liable to be discharged from its combinations into the atmosphere and lost. The essential points, therefore, in the preparation of commercial manures is to render the phosphoric acid soluble, to fix the ammonia so that it shall not escape from the material until applied to the earth. The first of these essentials is involved in the preparation of the various kinds of superphosphates from bones and mineral phosphates. The other relates to the fabrication of poudrettes, etc., from animal offal and refuse.

Artificial fertilizers of the character above indicated differ from ordinary or barn-yard manure in their superior activity, which arises from the greater ease with which the ammonia is generated and set free, when the material is subjected to the action of air and moisture, and from the increased solubility of the phosphoric acid, potash, etc. This, as is well known, explains why the effect of an application of guano, poudrette, superphosphates and manures of similar character is wholly expended in one season, while a single manuring, with the less active and energetic stable refuse, will nourish half a score of crops. With the superphosphates, this activity is due to the chemical treatment which the material receives when in course of preparation, but with the ammoniated fertilizers the remote cause lies in the highly organized condition of the materials from which they are derived, it being a truism that the higher any substance stands in the scale of organic life, the more complex will be its constitution, and consequently the more readily will it be decomposed. The effects of a highly organic origin in insuring the activity of a manure is seen in the case of Peruvian guano, the virtues of which are due to the fish which formed the food of the sea birds by which the guano was

deposited. The working of the same principle is also evident in the greater value of manure taken from the pig-sty as compared with that derived from the cow-stable, the food of fattening swine being richer than the hay fed to cattle. The rule holds true in a greater and more manifest degree with reference to the fertilizers made from the sewer refuse of cities and the offal of animals, of which the writer proposes to speak somewhat at length, in the following description of the

MANUFACTURE OF POUDRETTE

And other commercial manures at the works of the Lodi manufacturing company, made from notes taken during a careful examination of the establishment.

The company have been in existence for about thirty years, and until within the past year or two their method of making poudrette was identical with that employed in similar manufactories in Europe, a certain proportion of peat being added to conserve the ammonia. This was found, however, to make a manure too bulky for transportation, and, after many experiments and much expense, a plan was perfected by which the use of peat and chemicals could be dispensed with; machinery was also devised for separating the rubbish and extraneous matter from the material, so that by this means a much stronger and more efficient fertilizer is obtained.

Poudrette is a material made from the night-soil or fœcal matter of cities and from the foul offal of slaughter-houses. The Lodi manufacturing company have an exclusive contract for all the night-soil of New York city during some six years to come, and for that of Jersey city for three years, and have also managed to get control of all the butchers' refuse and dead animals of New York and Jersey city, and the offal of the great Communipaw abattoirs. All this immense mass of decaying organic matter is conveyed by boats to the works on the Hackensack river, to be converted into the dry, dust-like substance which, packed in barrels, is sent by railway and steamer to enrich the soil of farms and gardens hundreds of miles away.

The night-soil is taken from the city sewers in a thick semi-fluid condition, and run into the holds of barges containing from eighty to 300 cartloads, or from 60 to 200 tons each. Before this is done, however, it is required by law that the whole should be disinfected. This is accomplished by the use of what is termed carbolic or phenic acid, a substance that possesses great deodorizing and disinfecting powers, and which acts so effectually that when the hold of a barge

is filled and allowed to stand, the odor and emanations apparent to the sense of smell are hardly noticeable. When the barges are filled, their hatches are battened down, and they are towed to the works to discharge their loading. The quantity of this foul material thus removed annually is immense, not less than 48,000 loads, and requires the employment of eleven barges and of four different docks in New York city. A noteworthy item in connection with this transportation of the night-soil is the cleanliness of the barges, which is all the more noticeable from its contrast with the peculiar nature of their contents, the decks being as free from dirt of any kind as an ordinary thrashing floor.

When a barge has reached the wharf at the works, the hatch is taken off, and the unloading machinery is put in operation. This is worked by a steam-engine, and consists of a large scoop or bucket on the end of a hoisting rope, the bucket being so arranged as to fill itself when simply let down into the hold, and to empty itself when raised to the requisite height. The bucket lifts the night-soil from the hold and pours it into the top of a long inclined shute. In the upper part of this shute is a screen which separates the rubbish from the material. This rubbish is of all imaginable kinds, cobble stones and brick-bats, old boots and shoes, bones and broken crockery, with every once in a while some article of value. These last are the perquisites of the men that find them, and on this account the post of profit, though scarcely of honor, is that of tending the screen where such articles are the most likely to be seen. On one occasion the manager was obliged to interfere to stop a fight that was going on among some half dozen men about a gold watch that had been found in the mass, and at another time the screen tender left his work and kept tipsy for a week on a twenty dollar gold piece which he had picked from the screen. Coins of smaller value, silver teaspoons, forks, thimbles, and butter-knives, are not uncommon, and the laborer, who is expected to pocket what he finds, invests his revolting occupation with something of the interest of a lottery.

After the material has been passed through the screen, and had its rubbish removed, as just described, it flows down into a large reservoir, where its more solid and heavier portion slowly settles to the bottom. When this is accomplished, the surplus water is drained off into the river, and the deposited matter has then sufficient dryness and consistency to permit of handling and carriage in carts and barrows. In this condition it is wheeled to what are termed the floors,

which are simply plots of hard packed earth, on which the material is spread out to be dried by the action of air and sunlight. At those seasons when the floors cannot be used, and also in long periods of wet weather, the drying is performed in kilns constructed for the purpose. But this is so expensive that every week of sunshiny weather saves the company $500. The uncertainties of the weather constitute, indeed, one of the drawbacks in the business, for if fine and warm a "floor" may be properly dried in two days, whereas, otherwise, it may require a month. It should be mentioned that in order to facilitate the drying, the mass on the floors is gone over at intervals with a plow or cultivator, which loosens its texture, and favors the escape of moisture.

When the dried night-soil is taken from the floors, it constitutes a dark, friable substance, its bad odor is removed by the action of the acid, and it is now ready for the mills, by which it is reduced to a fine dust. The mills have shafts which rotate at a high speed, and are furnished with iron blades or arms, pivoted at their inner ends to the shaft, but capable of swinging, so as to yield in the event of striking any bit of hard rubbish that may not have been previously separated from the material. These shafts, with their blades or arms, are inclosed within cylinders having openings at the top, into which the material is thrown by elevators, and other openings at the bottom, which enable the milled material to pass to sets of shaking screens, which separate it into different grades of fineness. The mills are located on the second floor of the building, each one being furnished with an endless chain elevator extending downward to the floor beneath, where a great heap of the dried night-soil is placed in suitable proximity to the elevator. The elevator is provided with buckets or boxes, like those used in the elevators of grist mills, but much larger, each bucket holding perhaps half a bushel. A man with a dung-fork throws the material into the buckets as they are carried upward by the movement of the apparatus. The buckets empty their contents into the mill above. The material passes through the mill, and is reduced to a finely powdered condition, and falling upon the vibratory screens before mentioned, is separated into three parts, the first and second grades of poudrette, and the rubbish that may have escaped the separating process at the outset. The two former are fertilizers; the latter, of course, is waste, and is composed of cinders, sticks, pieces of brick, &c. The poudrette, as it comes from the mill, is a fine uniform powder, having a grayish

brown color, with little white specks that are minute fragments of bones. We now come to an improvement in the manufacture of this class of manures, which consists in the production of what is known as double refined poudrette. This is done by combining the first grade of the poudrette, the manufacture of which has just been sketched, with animal offal, by which means the strength and value of the fertilizer is materially increased. And here it may be of interest to note the nature of this offal and the source from which it is derived.

Aside from the dead animals from the cities, offal is brought from Communipaw, and consists, for the most part, of the intestines, livers, lights, etc., of the thousands of animals that are every week slaughtered there. This offal contains a considerable percentage of grease, which it is desirable to save. It is, therefore, put into large tanks and steamed. The hot steam melts and extracts the grease, which accumulates on the surface of the water formed in the tanks by the condensation of the steam, and is drawn off. The remaining contents of the tank are then shipped to the poudrette works. This offal is much more offensive to the smell than the disinfected night-soil, so much so, that, instead of letting it lie in an open reservoir like the latter, it is piled up in great heaps and covered over with earth, in order to keep the effluvia from contaminating the atmosphere.

In making the double-refined poudrette, a large quantity of the offal is very intimately mixed and incorporated with an equal portion of the first grade of the poudrette, formed as described directly from the night-soil. This is done under cover, inasmuch as wetting would materially interfere with the desired result. The poudrette, being very dry, absorbs the moisture from the offal and brings the whole mass into such a state as to enable it to pass through another mill similar to the first. This grinds up the offal and converts the whole into a powdery substance resembling the poudrette formed in the first instance, except that it contains a much larger proportion of bone, derived from the offal, and is more damp and sticky to the touch. This double-refined material falls from the mill directly into the carts, by which it is conveyed to the storehouse, a large wooden building capable of holding many thousand tons. The material is dumped upon the floor, load after load, and thus stored in bulk. Being packed hard by the passage over it of the carts and horses, the entrance of air into the mass, or the release of ammonia, is very slight. As no chemicals, peat, or absorbent materials are used it

might be supposed that much ammonia would be lost during the various stages of preparation, but nothing of the kind is evident, and the statement of the manufacturers that no appreciable loss occurs is borne out by the rapid evolution of ammonia from simply mixing a handful of it with a little quick-lime. The retention of ammonia in the night-soil may be ascribed to the disinfecting treatment by carbolic acid which the latter receives before being transported to the works, and which chemically fixes the ammonia. When the poudrette is mixed with the offal in the preparation of the double-refined product it is very dry and absorbing the ammonia from the offal retains it, just as dry earth is known to do in the so-called earth-closet, or as dry peat does when mixed with rapidly decaying constituents of a rich compost heap. At the time of our visit the laborers were carting and depositing the fresh material in one end of the storehouse, while the other end was occupied by an immense heap, said to contain 11,000 barrels, ready for barreling and shipment. The shipments at this season of the year amount to from 2,500 to 3,000 barrels per week, exclusive of cargoes in bulk. The greatest sales are made in New Jersey, the State where it is made, and its uses are best known. The demand is also very large from New York, Connecticut, and North Carolina, while other States require it in greater or less quantities; a considerable trade being of late developed in the southern States, including those bordering on the gulf.

From the foregoing sketch it will be seen that there are two kinds of poudrette, one which may be termed the common or cheap variety consisting simply of the second-grade of the product made of the dry night-soil; the other, or double refined, composed of the first grade of such product, combined and prepared with animal offal, which, from its highly organized and nitrogenous nature, is one of the very best enriching materials known. The former is more bulky, and is therefore best fitted for use where the cost of transportation is moderate; but in those cases where it is to be carried for long distances, the double refined, or concentrated fertilizer, will be found much preferable. It costs only about twenty per cent more than the other, and considering the difference in the method and manner of manufacture, there is no doubt that this comparatively slight increase in cost is more than made up by the additional strength and activity of the manure. Let us now turn to another department of the fertilizer manufacture, and consider the fabrication of

Phosphate Organic Manures.

Although poudrette, especially the double refined, contains a fair amount of phosphoric acid, and of course such a proportion of soluble potash as may have existed in the organic matter from which the material is produced, it is properly speaking, an ammoniated manure, because of the excess of the ammonia it contains. On the other hand the manures made from bones, which constitute one form of organic matter, owe their chief value to the presence of phosphoric acid, the ammonia, except in the case of raw or unboiled bones, existing in only a trifling proportion. Some twenty years ago it was the practice to convert the bones into superphosphate by treatment with dilute sulphuric acid, but of late this appears to have become obsolete, partly because the use of mineral phosphates has enabled a good superphosphate to be made at a much lower price than would be possible with bones alone, and partly because a large class of farmers prefer, for certain crops, the pure bone in the form of dust or flour to any superphosphate. For this reason the bones, which are mostly obtained from the western cities where large numbers of cattle are slaughtered, are simply ground to different grades of fineness in strong crushing mills. These mills are composed of several pairs of heavy cast iron rollers, arranged one over another. The bones pass between the upper pair of rollers, and are broken into fragments. These fall between the second pair and are crushed still finer, and passing thence to a still lower pair are reduced and comminuted until capable of being sifted through the sizing sieves. The product is made of several different degrees of fineness to suit purchasers; thus what is termed coarse bone dust is composed of bone ground smaller than one-third of an inch and mixed with an equal quantity of the fine bone dust. This latter is made fine enough to pass through sieves with meshes of one-eighth of an inch, while the bone flour, as its name indicates, is made to approach the condition of ordinary flour. The demand for these bone fertilizers is very great, and the supply of bones obtainable quite inadequate to meet it. In addition to those artificial manures, which may be characterized from their greater superabundance of ammonia or phosphoric acid, as the case may be, there are others in which it is sought to combine both these constituents in a more than ordinary degree; such a manure has been made at these works from some 1,500 tons of mingled bones, pigs' hoofs and hair brought recently from the west, and showing, by analysis, about seventeen per cent of ammonia, in addition to the phosphoric acid

inherent in the bones. Much difficulty was found in reducing the hoofs, until at last the plan of subjecting the material to the action of superheated steam was hit upon and found to bring it into the required condition. Another fertilizer of similar character is called nitro-phosphate of lime. It is composed of the animal offal before described, and which is rich in ammonia, mingled in due proportions with super-phosphate. It is claimed by the manufacturers to be equal to Peruvian guano in its immediate, and more lasting in its remote, effects.

Mineral Superphosphates.

As before intimated, the manufacture of superphosphates is now carried on almost exclusively with mineral phosphates found in large deposits in various parts of the world, among which those of South Carolina and of the island of Navassa are among the most available and extensive. The superphosphate made by the Lodi manufacturing company is manufactured from equal parts of the phosphates brought from these two localities. The phosphatic material comes in bags, and in a condition as fine as flour, having been ground in a burr-stone mill. It is a yellowish looking substance, as heavy as ordinary plaster. In its natural or unground condition it is so refractory that acids would fail to reduce it, and hence the necessity of grinding. Even in its form of flour it holds its phosphoric acid with such tenacity that its application previous to chemical treatment would produce but little good, and as a consequence it must be converted into super-phosphate, which makes the phosphoric acid soluble so that plants may take it up from the earth. This is done by simply putting the ground phosphate in small batches into an iron kettle, and pouring diluted sulphuric acid or oil of vitriol upon it. The oil of vitriol drives out the phosphoric acid from a part of the lime, and forms a sulphate of lime. The liberated phosphoric acid immediately unites with the other portion of the phosphate, which thus contains twice as much of the acid as it did before, and constitutes a new chemical product termed superphosphate of lime. Now, all the phosphoric acid in this superphosphate is soluble, and consequently acts at once when used as a manure. We here close our sketch of the Lodi manufacturing company's works, devoting a brief space to some matters of general interest connected with the subject, and a few words to the consideration of

Other Artificial Manures

Which are exciting more or less attention, and among which fish guano holds the most prominent place. This is made from the fish known as "moss bunkers," and caught in great quantities along the Atlantic coast. Their immediate use is in the manufacture of an oil, which is obtained by pressing them in bulk, after being boiled, under strong presses. The residue of the fish is composed of bones and flesh fibers. Both of these are valuable for manure, but the material is not a guano in any sense of the term. The bones are rich in phosphoric acid, while the flesh, aside from its capability of producing ammonia by decomposition, is commonly believed to contain a larger proportion of phosphorus than that of animals; a proposition which the writer has never attempted to verify, but which, if true, would add materially to the manurial value of the product, inasmuch as the phosphoric acid in the flesh would be valuable in a high degree. It is stated by some that they have found a much larger percentage of water in the fish guano purchased by them than was at all desirable; and, indeed, to put the pomace into markets in the condition in which it comes from the press, is falling far short of making the most of the article. It should be dried at a moderate heat, so as not to dissipate the ammonia, and ground, as is done with poudrette; and in this form would undoubtedly form one of the most valuable of all the commercial manures now before the public. The same remark will, however, apply to almost any form of animal matter, such as the lobsters, king crabs and mussels found in large quantities at some points on the New England and New Jersey coasts.

Application of Commercial Manures.

Inasmuch as artificial fertilizers are comparatively expensive, it is desirable that they should be used to the best advantage, or in other words, that none of their virtues should be lost by carelessness in using them. Except on grass lands, it is recommended to apply the ordinary grades of poudrette, bone-dust, bone-flour, and the like in contact with the seed that is in the drill, or in the hill. Yet this will not answer with the more concentrated materials, like the double refined poudrette, nitro-phosphate, or guano. These fertilizers should either be well blended with earth in the vicinity of the seed, or should have interposed between them and the seed a layer of soil. The quantity of guano that may be profitably applied per acre must, of course, vary with its quality, with the nature of the soil, and the

kind of crop to be grown, but in the average of instances will approximate to that given for double refined poudrette, viz.: For wheat, rye, oats and barley, from 300 to 400 pounds; for buckwheat, 200; for turnips, twice as much; and for top-dressing on grass lands, from 250 to 400. All ammoniated manures should either be intimately mixed with the soil or applied thereto before or during a rain, in order that the ammonia may be retained and carried down within the reach of the roots; whereas, if left upon the surface during hot weather, a portion of the ammonia would be dissipated, and the remainder would lie inert, out of the reach of the plants. With reference further to ammoniacal manures, it may be mentioned that inasmuch as they are believed to be the most active in developing the growth of straw and leaves, they should be applied as early as possible; while the superphosphates, which tend mainly to the development of the seed or kernel, may, when desired, be applied later in the season. The question is frequently asked, by those unfamiliar with the chemistry of manures, whether lime or ashes may not be mixed with poudrettes and similar products, to advantage. *This should never be done*, for the reason that either lime or potash is a stronger alkali than ammonia, and if brought into contact with any of its compounds will usurp its place, thus liberating the ammonia, and destroying the value of the fertilizer.

ADULTERATIONS OF COMMERCIAL MANURES.

The adulteration of artificial fertilizers by dishonest dealers has been coexistent with their manufacture and sale from the beginning, and the query is often made if there is no cheap and simple test by which the farmer may ascertain the exact nature of the material he buys, and thus protect himself from imposition. To this there can be but one candid answer. That there is not, and that the only certain and trustworthy test of the probable value of this class of manures consists in a careful analysis by a competent chemist, which will often cost as much or more than a ton of the fertilizer. The manufacturer can afford this in order to know and to keep up a standard of his products, and the dealer can afford it if he suspects the manufacturer; but the farmer will find the outlay too heavy, and hence his only reliance is upon the integrity and standing of the seller. It is true that the addition of lime to guano, poudrette, etc., will cause the liberation of ammonia, which will indicate the ammonial nature of the substance to the sense of smell, and even afford an approximate idea of the

quantity. But the rapidity and facility of this liberation of the ammonia is liable to be modified by circumstances, as, for instance, the more or less moist condition of the material, or the greater or less causticity of the lime, and consequently is a poor index of the actual value of the manure. The fact is, that the province of the farmer is one thing, and that of the chemist another. The farmer weighs his materials by the hundred weight; the scales of the chemist are sensitive to the five-thousandth part of an ounce. The farmer estimates the value of a prepared manure by the bushels of grain it will cause to grow on a field; the chemist, by the grains or pennyweights of potash, phosphoric acid or ammonia he may find in a sample; and the two methods are so essentially different that it is unavailing for the practitioners of the one to swing the tools or babble the language of the other. The only sure path for the farmer to follow in order to avoid being victimized, first, is to purchase of dealers whose commercial standing is, in a measure at least, a guarantee of their integrity, and second, to make themselves so well acquainted with the best methods of using or applying the fertilizers to the soil that its virtues shall not be lost by their own carelessness. If this is done, a few trials will enable the farmer to approach a correct estimate of the true value of his purchase.

FUNDAMENTAL PRINCIPLES.

In closing this sketch it may not be out of place to recapitulate some of those principles involved in the successful management and use of artificial or highly concentrated manures.

1. The value of such fertilizers is to be estimated by their proportions of ammonia and soluble phosphoric acid. The quickness of their action, as compared with that of barn-yard manure, is due to the rapidity with which those two substances are distributed through the soil and made available for the roots of plants.

2. In using guano, poudrette, and other ammoniated manures, especial care must be taken to prevent the flying off of the ammonia. This is done by covering or mixing it with surface soil, by applying it under such circumstances that the rain will carry it into the ground, and by strictly avoiding admixture in any way with such alkaline substances as potash, and lime.

3. The value of phosphates is due not so much to the quantity of phosphoric acid in them as to its solubility. This is the reason why superphosphate is better than a simple phosphate. The phosphoric

acid in the former is in such condition that it may be readily taken up by plants; while on the other hand, the acid in the latter is nearly insoluble and the material benefits the soil and helps the crops very slowly.

4. The more highly organized the material from which a fertilizer is made the richer and more readily decomposed it will be; the richer the manure and the more prompt the decomposition, the more rapid will be its action; the greater the activity, the sooner is the effect exhausted. This explains why guanos and poudrettes which are made from highly organic matter act at once, produce heavy crops and show the most of their effect in a single season. Compared with tardy manures it is the quick penny against the slow shilling.

5. The mechanical condition of a fertilizer has much to do with its efficacy when applied to the soil. As a general rule, the finer the material the quicker it acts, and, of course, the sooner it is exhausted. Thus in the use of bones, bone flour will act more rapidly, but bone dust will help the soil for a longer time.

The only safeguard of the farmer against loss in the use of commercial manures lies in dealing with honest men, and in studying closely the best methods of applying the material to his crops. Many a hard working tiller of the soil has been duped by venders of adulterated fertilizers, and on the other hand, many an upright dealer has been accused of fraud because the farmer in his ignorance mismanaged the stuff after he had bought it.

Adjourned.

PROCEEDINGS

OF THE

POLYTECHNIC ASSOCIATION.

The Polytechnic Association of the American Institute held its regular meeting on Thursday evening, May 14th, 1868, Samuel D. Tillman, LL. D., presiding.

Fossil Shark Teeth.

At the opening of the meeting, Dr. J. V. C. Smith, of Boston, in a few remarks spoke of the fossil shark, remains of which exist in the older geological formations at Gay Head and other points on the Atlantic coast, and exhibited a fossil tooth of the ancient fish, found about fifteen feet below the surface at Richmond, Va. The tooth has a sharp cutting edge, and is about six inches in length, and, at its broadest part, four inches and three-quarters wide, with a maximum thickness of an inch and a quarter. The surface is, for the most part, of a greenish color, and the fossil weighs in the neighborhood of a pound.

Dr. Feuchtwanger stated that the same or similar fossil teeth were found in the green sand of New Jersey, indicating that the primitive sharks were of immense size.

Longevity.

Dr. Smith also read a brief but interesting paper on the subject of longevity, citing many instances, from remote and modern history, of persons who had exceeded 100 years of age, the longest life known since primeval times being one that had extended to 169 years.

Trinity Church Clock.

Mr. James Rodgers made the following remarks:

Mr. Chairman, I desire to say a few words in reference to some observations contained in an essay on the *Public Clocks of New*

York, which was recently read before this association,* and in which Trinity church clock and its maker were not fairly treated.

I have the honor of saying that I built Trinity clock, and I take pleasure in referring to it as a specimen of workmanship and as a time-keeper. It is the largest clock in this country. The three great wheels are thirty-one inches in diameter, two-inch face each; the other wheels in like proportion, of the best brass and well hammered; the wheels all work into box pinions, with brass boxes; the leaves are cast steel, tempered and polished; there are nine pinions and nine wheels in the running, and hour and quarter trains; the whole works are built in a strong, substantial and workmanlike manner; it has run full seven days ever since it was placed in the steeple; it will be remembered that the clock strikes 4,320 strokes more in a week than any other clock in the city; the pendulum-rod is made of white pine, well saturated with best tallow and beeswax to keep out dampness, and, if the clock is properly taken care of, it will keep as correct time as any other tower clock in this city or in the world.

I received a gold medal from this Institute for this clock, the report upon it having been made by Mr. James Gemmel and Mr. S. W. Benedict, gentlemen of the greatest experience and soundest judgment in matters of time-keeping. I beg to call your attention to the following extract from the report made by them October 22d, 1846:

"We have examined the clock, and find it the largest we have ever seen. The whole is of brass, steel and iron, with the exception of the barrels on which the ropes are wound. The arrangement of the whole, as well as the make and finish, is done in a masterly manner, and does great credit to the skill and ingenuity of the maker, and it deserves the highest praise of the American Institute."

For several years I had charge of the clock, and its value as a time keeper was patent to all frequenters of Wall street.

The ridiculous story told by the essayist, about the employment of the sexton's son as a messenger, I pass over as unworthy of notice, it being entirely devoid of truth.

I do not know that you will consider the essayist's references to Trinity clock deserving of this notice, but it seemed to me proper to make a true statement of the case, to the body which listened to the essay; and I request that the same publicity be given to these few remarks, as was accorded to the essay which is the cause of them.

* See *Transactions of the American Institute for* 1867–8, *p.* 798.

The following notes on scientific progress were presented by the Chairman:

Casting Steel under High Pressure.

Mr. Galy Cayalat of France has invented a process for making sound steel castings by means of gaseous pressure applied to the metal as soon as it is poured into sand molds inclosed in iron flasks. The pressure is generated by exploding about a quarter of an ounce of a powder consisting of eighty parts of saltpeter and twenty parts of pulverized charcoal. It is said the invention has been successfully applied in France in the casting of steel cannon.

Venom of Toads.

Experiments made with toads by Gratiolet Gloez and Vulpian prove that matter is exuded near the ear which is poisonous when introduced into the tissues of other animals. Dogs, after biting a toad, show signs of pain. But the bite of the toad is not poisonous. It is said some Indians in South America use a fluid obtained from the back of the toad, in place of curara, for poisoning the tips of their arrows. The ordinary toad may be handled with impunity, but should the secretion alluded to come in contact with abraded skin unpleasant sensations might ensue.

A New Disease.

Dr. Duchenne of France has described a new malady found only among children and young persons. It commences with a partial paralysis indicated by feebleness and unsteadiness in movement, which, if not then checked by proper remedies, is followed by an unnatural enlargement of the muscles usually, first in the calf of the leg, then by a general paralysis, when death ensues. He has extracted, by means of an *emporte-piece* or nipping tool of his own invention, portions of the muscle which, on examination, are found to contain, in the first stages of the disease, an undue proportion of fibrinous matter, and afterward a fatty deposit.

Letter Book.

Messrs. P. Garrett & Co., of No. 702 Chestnut street, Philadelphia, manufacture a letter press copy book for taking instantaneous copies of manuscript, which has been found to answer in the best manner the purpose for which it is intended. A sympathetic ink is used with the paper of such a consistency and character that when a page of

manuscript is written, by placing it under a leaf of the book and rubbing the hand over the paper, an excellent copy is obtained. It is a valuable aid to business men heretofore accustomed to the irksome process, which requires a wet brush, absorbing paper, a press, and some patience.

Mural Painting.

The application of colors in the decoration of walls and ceilings has been greatly facilitated by the use of alkaline silicates, or water-glass. Formerly, fresco painting was executed on stucco made of lime or gypsum, into which the color or pigment will sink and become durable, but it is essential that in this case the whole painting be completed before the coating of stucco is dry, for after it has assumed that condition the painting cannot be retouched. Very few, if any, of the ancient paintings found on church walls are genuine frescos, as has been generally supposed; they are simply distemper paintings, that is to say, colors ground up with size and water, applied to common plaster. Fuchs was the first to obviate the difficulties found in true fresco work. His improved method consists in applying to the surface water-glass cement, made by mixing a soluble silicate of soda with powdered marble, with dolomite, or with quartz sand, and a little dry slaked lime. Upon this coating the painting is made by means of mineral colors ground up with pure water. The work may be prolonged for any required time. When it is finished the colors are fixed by washing the surface with a mixture consisting of four or five parts, by measure, of water-glass saturated with silica, and one part of monosilicate of sodium, the whole being diluted with one-half its bulk of water. This kind of silicious painting is very durable, and may be applied to earthenware or tiles after their surfaces have been prepared with water-glass. The process invented by Kuhlmann is more simple, as less care is required in preparing the surface and fixing the painting. He grinds his colors with an alkaline silicate, which may even be applied to wood, provided it is free from resin. When a very porous stone is to be covered, it is best to silicify it before applying the colors. A silicious solution, of fifteen to twenty degrees Baume in strength, may be mixed with colors ground in water; but for painting on glass or earthenware the solution should be more concentrated.

For the benefit of those who wish to apply, under their own supervision, water-glass for paintings and decorations, we subjoin the following information from *The London Builder:*

Mortar, which is composed of lime and sand is the best ground for water-glass. The sands used must be free from salts, ground flints, &c. The so called artificial sands are the best; they have an even and sharp "corn." The lime may be slaked; if fresh lime is used it should be powdered fine to prevent "blowing;" in both cases the mortar should be rather poor in lime. Roman cement, mixed with mortar or with sand, also forms a good ground; but plaster of paris (gypsum) must be avoided in the last layer of mortar.

The ground should be of an even grain, not smooth; the larger the wall and the details to be painted, the coarser the grain of the sand may be. After the ground is perfectly dry, it ought to stand for a week or two before painting is commenced. The colors used for painting pictures, decorations, or large surfaces are simply ground fine in pure water; the water is best purified by boiling. The colors are applied with water only. Those artists and decorators who are used to paint in tempera, in body-colors or distemper, will find this process easy; those who are used to oil painting only require some practice to master the details of manipulation. Before application of color moisten the places with water, and should the ground become dry under the brush, it is kept moist with a syringe, throwing the water in the form of a fine mist. In all cases where it becomes necessary to paint over again, to deepen or highten the colors, the places ought to be always moistened with a syringe. While painting is going on the colors must not be touched or rubbed with the finger, as they are now only "bound" with water, and are soon damaged and rubbed off. When a picture or a wall is finished the colors must be "fixed," and now, for the first time, water-glass comes into operation.

For fixing the colors, the "fixing water-glass" is used. The surest way of using it is to dilute the solution with pure water considerably. That water-glass which is of the consistence of thick syrup may be diluted with six times its bulk of water; that which is sold as "fixing solution" with an equal bulk of water. The whole surface is evenly syringed over. Care must be taken not to apply too much, or the colors may flow into each other. After the lapse of a day, the water-glass having had time to combine and harden, a second coat is applied; this time the solution may be a little stronger. In most cases the colors will all be "fixed" when the second "coat" is dry; if, however, some of the so-called meager colors, such as black, &c., still rub off with the finger, it is best to go over these with a soft brush and water-glass.

There is no advantage in adding more water-glass than is absolutely necessary to fix the colors. If too much is used, the surface becomes bright, which is also the case if too much lime is in the water. Those bright places turn, in the course of a few days, into a white film, which, however will disappear in the course of time, or must be removed with a sponge and clean water. The safest way to insure success is to begin the fixing with a weak solution, and repeat it three or four times, rather than to use a strong solution at once.

The colors and pigments to be used are as follows: Zinc white; permanent white (artificial sulphate of barytes); dark yellow, burnt, and brown ochre; terra de Sienna, raw and burnt; cadmium and chrome yellow; red chrome, green chrome; blue and green ultramarine; oxyd of iron in red, brown, and crimson; burnt umber; mineral and lampblack. No vegetable color is admissible. Vermillion, cobalt, and light ochre ought to be avoided also.

For large surface, for walls where expense is a consideration, lime and chalk (whiting) may be used, only those latter do not cover well; a little addition of zinc white will balance that defect and produce a good "body." It should also be borne in mind that water-glass is antagonistic to oil-paint; if any oil-painting is in proximity to water-glass painting, or upon a wall to be fixed, the oil-paint ought to be covered with paper before fixing with water-glass, otherwise the oil-paint will suffer. Woodwork when new, where a smooth and even surface is not required, and where the smell of paint is too obnoxious, may be coated with water-glass. In that case it is recommended to "bind" the colors with weak size, and apply the water-glass afterward with a brush. Woodwork is also protected against fire by the simple application of two or three coats of pure water-glass, without any pigment. The wood so treated becomes darker.

One more observation as a guide to the operator is this; all the colors become a little darker under the fixing process, but in the course of a few days they regain their original tone. Certain colors, such as oxyd of iron, artificial white barytes, and some of the ochres, contain sometimes smaller or larger portions of sulphuric acid. These colors must therefore be washed with plenty of pure water before using them for painting.

The reading of the last item drew forth considerable discussion, in the course of which Dr. Vanderweyde stated that coating a wall with size, and washing it with alum water, by which a sort of a leather is formed, which can be washed without injury. This is a very good surface for fresco painting.

Engraving.

Dr. P. Vanderweyde explained a comparatively recent method of engraving, in which the design is first drawn in ink, of which water-glass is an essential constituent, upon a block formed of such material as to readily absorb the same. The ink hardens the material so that the parts between those to which the ink is applied may be brushed away, so that the design stands out in relief. Inasmuch as the blocks are too soft to be printed from, stereotype plates are formed therefrom, from which in their turn the impressions may be taken.

Underground Railways.

The hour for taking up the subject for regular discussion having arrived, Mr. J. K. Fisher read a paper on "Underground Railways," of which the following is a condensation:

Mr. Fisher described four plans: First, the Metropolitan, in London; second, the New York Underground, assumed to be the same as the "Central," which is chartered; third, the Arcade; and fourth, the inter-street open-cutting plan, by Messrs. Worthen & Schuyler.

The London "Metropolitan" railway is a fourth in open cuttings and three-fourths in tunnels, the tunnels having small openings for ventilation. When running in the tunnels, the steam is exhausted into the tank, the draughts are closed, and combustion is suspended, to avoid contaminating the air; yet it is complained that the air is offensive, causes headaches, stinging sensations in the throat, coughs, and sulphurous taste on the palate; and two persons had died on the railway; and the verdict on one, a young woman apparently in good health, was, that her "death was accelerated by the suffocating atmosphere of the underground railway."

The New York plan is a tunnel all the way, under streets, with no openings except through hollow lamp-posts fourteen inches in diameter, and at the stations. The promoters of this plan expect that these means of ventilation will be sufficient; that locomotives may exhaust their steam through their chimneys all the way.

The Arcade plan is to make a new street under the old one, with sidewalks extending up to the house walls, the ventilation to be through the areas, five feet wide on each side. The promoters expect that the sub-street will be satisfactorily ventilated and lighted through these areas.

The inner-street plan is to make an undergrade street, as much as

practicable in open cuttings, through back yards, running under cross streets and under buildings that cannot be bought at paying prices.

Mr. Fisher would modify this plan so as to go under Canal street, instead of over it; and he would make it thirty-five feet wide wherever practicable. For some years, until existing buildings are removed or modified, it may be necessary to have more tunnels than are agreeable; but, as the income of the company increases, buildings will be bought and removed, and ultimately the way will be open, except under the cross streets, and it is expected that the ventilation will be satisfactory.

Comparing the three New York plans, Mr. Fisher preferred the open cutting, on account of its free ventilation and light. The proposed means of ventilation of the others are insufficient. And room cannot much longer be spared for areas, or even common lamp-posts, much less for the larger ones proposed. The gases and vapor slowly ascending through the areas would go into windows and doors, and render buildings unpleasant. In the open cutting, they would be projected upward by the force of the steam blast in the middle of the opening or street, and counter-currents of pure air would descend at the sides, so that only pure air could enter windows in ordinary weather. In reply to the claim relative to the under sidewalks and well-lighted under stories proposed by the Arcade company, he said, that, in his opinion, the under sidewalk, on account of its insufficient light and difficulty of access, would not compensate for the loss of five feet width of the upper sidewalk, and the under stories would be much better lighted from the undergrade street. Light room and street room would be combined; the new street should have sufficient width to light the buildings well, even to the basements and sub-basements, down to the level of the new street.

Having compared these plans, as to light and air, and economy of land damages, and claimed that the space taken for the inter-street would not damage property not yet built on, because the light room is more valuable than the ill-lighted buildings that now exist on many lots, he proposed a plan of his own, by which a higher speed than is attainable on rails can be attained. The plan is applicable in the tunnel or the arcade; but he would prefer the open cutting. It is, to floor the street with iron, as level and smooth as possible; and to run steam carriages. Their average speed will be greater than that of heavy trains, because they can load for distant places, and run through without stopping, passing the way-carriages; because they may safely be built light, as in case of breaking down, they will

slide along and not injure passengers, because their wheels will be free from the friction caused by flanges, cones and false shapes caused by wear, and because they will use less power than heavy trains, and may, therefore, drive their fires all the time, in cases where heavy engines have to shut their dampers and exhaust into their tanks, as in the tunnels of the Metropolitan railway.

On this line, a train weighing 122 tons, with an average of fifty-five passengers (125 tons total), starts every five minutes. The stations are half a mile apart; and, with trains so frequent, each must stop at all stations. The power required to start every half mile is so great as to double the consumption of fuel that would be required for running through; yet the number taken at a way station could often be taken by a carriage weighing a twentieth as much as the train. The result of this great waste of power, and restraint on making steam, is that the speed averages eleven and three-quarter miles an hour. A higher speed could be got if they could make steam all the time; but, even then, the frequency of the stops would prevent so high a speed as is needed. It is claimed that steam-carriages, on iron floors that are as true as rails, can run faster than ordinary railway trains; and can economically average thirty miles an hour for the long traffic, and can save much expense on the short traffic.

The average weight per passenger on the Metropolitan, is 5.108 lbs. An eighth of this is deemed a fair allowance for steam-carriages that may be run in greater or less numbers at different hours of the day, as traffic requires, and that can thus be made to average half-loads. And the consumption of fuel, and consequent difficulty about the atmosphere in a tunnel, or close way, will be in proportion to the total weight moved.

The chairman spoke of the three most prominent plans for railway transit through the city of New York, namely: The tunnel railway, the elevated road, and the Arcade plan.

Mr. James Montgomery spoke at length of these plans, condemning the underground plan, on account of the large amount of carbonic acid gas, which would be always in the tunnel.

Mr. Melville C. Smith stated that the Legislature appointed a committee to come to this city to examine the best means of relieving this city, and the most feasible means of transit to the upper end of the island. The result was, about forty plans were submitted to them, only five of which seemed to be practical. After a careful investigation of all the facts, the committee decided that there was

great need of an underground road. The Arcade plan was most approved and most feasible. There was no plan yet brought forward that claimed so many good points as this. There are no very serious objections to it that he could hear.

After deciding to continue this discussion, the association adjourned to next Thursday evening.

May 21, 1868.

Professor SAMUEL D. TILLMAN in the chair.

The meeting was opened by the reading of a communication from Professor Robert P. Stevens, dated Guayana, South America, April 4th, 1868, as follows:

THE GOLD FIELDS OF GUAYANA.

Prof. R. P. Stevens.—A few preliminary words upon the history of this newly developed auriferous territory will be interesting, and prepare the way for my future remarks.

The close of the fifteenth century and beginning of the sixteenth was marked by the wildest schemes for search of precious metals ever known in commercial circles. From the time of the discovery of the Amazon river by Orrellana, there had grown into the belief of the then agitated world, faith in the existence of a land of untold and fabulous wealth, called *El Dorado*, or the "gilded king." Sir Walter Raleigh, who had mingled much with Spaniards, and was well posted in current Spanish literature, had the firmest faith in the existence of such a gold field; and fitted out, mainly at his own cost, three expeditions for the Orinoco river, in search of the precious metals. Almost every commercial nation also sent out costly expeditions, all of which miserably failed. For nearly two centuries this El Dorado has remained a fable, a myth, as for nearly a century it was a will-o'-the-wisp, leading to lavish expenditure of money, men, and lives. No other gold field, known to man, has had such treasure of wealth and blood fruitlessly lavished upon its search as those of Venezuelian Guayana.

Guayana is divided into two natural hydrographical basins, one, and the largest, is that of the Orinoco river. The other, and smallest, is that of the Essequibo, or its affluents. The larger was in the beginning of this century extensively explored by Von Humboldt. Of it, he says in general terms, that its rocks were *too old* to be rich

in auriferous wealth. He was one of the first geologists to draw a line between early and late rocks in geological history bearing gold. Since then this distinction has been abundantly confirmed by Murchison, Forbes, and Whitney, and other authorities. He was correct. The Orinoco valley has never produced gold, either from its rocks or sands. The Essequibo basin was never visited by Humboldt; it has never been explored by competent scientists. Much of it is *terra incognito* to day. Schomberg visited the southeastern portion, but the middle is entirely unknown, and the northwestern has been but partially explored.

In the year 1854, Dr. Lewis Plassard, a French physician, visiting the old mission village of Tubuken, situated on the banks of the Rio Yuruary, went down to this stream for his daily bath, and there and then discovered auriferous quartz among the water-worn rocks of this stream. The Yuruary is the northwest tributary of the Yuruan, which empties into the Essequibo near Georgetown in British Guaiana. Since then, with varying success, this portion of the valley of the Yuruary has been producing gold. The extent, continuity, and richness, and produce of its quartz veins have been well proved, and the fruits thereof have gone to Europe in annually increasing quantities.

Opposite Tubuken, rising from the south bank of the Yuruary, there stretches off southwesterly a low range of mountains for about fifty miles. The width of this range varies from six to fifteen miles. About twelve miles above Tubuken, the Yuruary commences to break through this range of mountains, and by means of this natural excavation we are enabled to learn the mineral constituents of this range of mountains. Expressed comprehensively, they are metamorphic; in detail, they are hornblendic, talcose, micaceous and brecciated slates. Quartz veins are confined to the talcose and brecciated portions. The talcose have suffered much from decomposition, and appear more as mottled and indurated clays, than as rock.

The valleys of the Mocupio and the Iguan are the only ones of these mountains, save the main valley of the Yuruary, which have been searched for gold. These support, from vein and placer mining, a population of about 2,000 people, living in seven palm-thatched, mud-walled villages, the central one of which is Nueva Providencia, where is situated the church and offices of the department, and where resides the curate and prefecto.

Gold is obtained from its mating in the most rude and primitive manner, no other machinery is used than the hammer and common

mortar and pestle. Oftentimes Indian women can be seen rubbing a piece of gold quartz upon a stone, having an artificial groove, where is placed a small globule of quicksilver. Her patient attrition liberates the gold, the quicksilver amalgamates it, and the application of frequent drops of water removes the abraded quartz. The annual production of the mines is about $600,000.

Looking over the intervening country between the Gold mountains and the Orinoco river, slates and rocks somewhat similar to those of the Yuruary reach to the southern base of the Imitacee mountains. This range of mountains is composed of hornblendic gneiss, and it forms the dividing rim between the river basins of the Orinoco and Essequibo. We cross this divide in the first day's ride from the Orinoco. On the east, also, it forms the divide between the Essequibo and the Atlantic ocean. Looking southwards over and beyond the Gold mountains, there stretches a wide plain of tropical verdure, to the sandstone mountains of Parima; beyond lie the plains and eternal forests of Brazil. Through this intervening country no white man has gone and returned. Looking over westward there is a wide stretch of plains to the Paraguas river, a large confluent of the Caroni, when again occur similar slates to those of the Yuruary, also rich in auriferous veins. Beyond there is succession of plain and curve filling up the great central valley of South America, which reaches on to the base of the great Andian chain, the backbone of the continent. Such, Mr. President, is my brief notice of Guayana and its gold-fields. I am here, in these tropical forests to examine, locate, and survey a grant of eight hundred acres. I am progressing favorably in my work, and confidently hope for satisfactory results. The Polytechnic, over which you so pleasantly preside, will be duly informed of the final results of my labor.

ALUMINUM MEDALS.

Dr. Dubois D. Parmelee exhibited some medals struck from pure aluminum manufactured by Parmelee, Webster & Co., at Hunter's Point, L. I. Dr. Parmelee stated that he had only a few weeks since made the first pound of aluminum reduced in America, and had recently cast a single bar weighing five pounds, which is now in the United States mint at Philadelphia, for the purpose of experimenting as to the adaptability of this metal for coinage.

Iron.

Attention was next directed to the reading by Dr. Feuchtwanger, of a paper on iron, in which he spoke briefly of the history of this metal as used among the ancient peoples of the earth, and mentioned its wide diffusion in the mineral, vegetable and animal kingdoms, and in the meteorites supposed to be splintered from other planetary bodies. He then proceeded to a consideration of several of the 200 different varieties of iron ore, one of the principal of which is the magnetic or bog iron ore, containing about seventy per cent of the metal, and from which the iron of New Jersey and Pennsylvania is made; as next to this was mentioned the Franklinite, which, in addition to its iron, contains about sixteen per cent of manganese, and is used in the iron manufacture as an equivalent or substitute for the German spiegeleisen. The speaker also spoke in a few words of the red oxyd or hematite, which contains about seventy per cent of iron, and is employed in the production of much of the iron made in the State of New York, and treated of various other kinds with reference to their special adaptation not only in the manufacture of iron, but of steel. The chrome iron ore is of an iron-black color, and contains about sixty per cent of chromic acid and twenty per cent of iron. This mineral was stated to be abundant in the United States, especially in Maryland, Pennsylvania and California.

Iron pyrites which contain fifty-three per cent of iron and forty-seven sulphur, cannot be employed in the production of iron of good quality, owing to the impracticability of wholly extracting the sulphur, but is largely used in the manufacture of sulphuric acid and copperas, and also to a great extent by dyers in making a black dye.

Mispickel is an arsenical pyrites, very abundant in Cornwall and Saxony, and largely employed in the production of arsenic. In the mines of Nova Scotia this mineral has gold associated therewith.

Lignite in New Jersey.

Dr. John F. Boynton, of Syracuse, said he had just returned from an examination of lignite, near Keyport, N. J. Perhaps some portions of these lignites are diffused still higher, and belong to the tertiary period. He took some of these specimens for examination, which were found about twenty feet deep; they were some four feet four inches long. Two tons of it were sent to a manufacturing firm in Water street, in this city, and they were using it in furnaces for driving their machinery. It burns very freely and with considerable

flame. It contains some sulphurets. It can be mined very easily, but artificial roofs must be made for these mines. As it is near the shore, boats can be brought quite near it to load. This lignite is more modern than the Pennsylvania coal, and probably belongs to the age of reptiles, many of their tracks have been found in the Triasic rocks. How is it that we cannot find any of the bones of the animals that we suppose have made them? Only parts of skeletons, with short arms and long claws have been discovered, and the tracks alluded to would seem to be made by them. The long legs denote them to be of the warm-blooded species. The legs of these animals, it would seem, were about eighteen inches long; they had two feet, with a trail behind. Nearly perfect skeletons have been found in New Jersey. Yet much larger ones have been found in Colorado territory, being there some thirty-four feet long. This coal came into existence simultaneously with or just after the great reptilian period.

FOSSIL VERTEBRA OF A GREAT WHALE.

A fossil bone was exhibited, concerning which the chairman said that it "measures two and a quarter feet in circumference, and is a portion of the great skeleton lying in a branch of the Tar river, North Carolina, at a point a few miles south of Enfield, Halifax county, where it has been used for many years as a foot bridge across the stream. The specimen shown was presented to the American Institute by the Rev. Wm. H. Knapp, upon whose farm most of the skeleton now lies, and who states that its length is two hundred and forty feet. The specimen has been examined by Mr. Waterhouse Hawkins, who pronounced it to be the vertebra of a whale of enormous size, and further ventured to express the opinion that all the organic remains found extending over a length of two hundred and forty feet did not belong to one animal, although only a personal examination of the locality would enable him to speak decidedly on the point. On being asked whether it might not be the skeleton of a member of the saurian or lizard species, he replied in the negative, inasmuch as the bone bears marks of having belonged to one of the mammalia."

NEW EMERY WHEEL.

Dr. Warren Rowell presented a new emery wheel, made of glue and emery, formed in a mold. Before the emery is quite dry, it is taken out of the mold and dried, which requires about a month. The wheel is sharpened with a damp sponge.

New Furnace for Roasting Ores.

Mr. Vivian read a paper describing his improvement in furnaces for roasting pyrites and other ores. The inventor claimed that his furnace possessed several important advantages over those commonly in use.

Estimated Weight of Minerals.

Dr. Lewis Feuchtwanger.—Frequent inquiries from persons interested in the sale of mineral lands induced the author to calculate and combine tables, which he thinks will prove of great service. If the purchaser of a clay, ochre, or coal bed, or of an iron ore deposit, either pyritic, magnetic, spathic, specular or hematite, blende, Franklinite, copper ores of the various grades, or galena or any other mineral found in nature, would ascertain the extent of the vein, and calculate into cubic feet, he must find the weight of a cubic foot.

It is known that 1,728 inches comprise one cubic foot, and that one cubic foot of water weighs at a temperature of sixty degrees Fahrenheit, sixty-two and a half pounds avoirdupois. By ascertaining the specific gravity of say lead, copper or iron, and multiplying with sixty-two and a half pounds, the exact weight of one cubic foot of these ores is obtained; it may also be easily ascertained how many cubic feet are contained in a ton of many substances; for instance, it is known that one ton of sand contains twenty-three and a half cubic feet, and a ton of marble or granite ten and a half cubic feet; and by these means we can also find out the capacity of certain mineral lands.

Although the author's first intention was to begin with the most common minerals or ores used for producing metals, such as galena, blende, copper pyrites, etc., on reflection it was thought best to arrange all substances the relative weight of each cubic foot of which is to be ascertained in alphabetical order:

	Pounds Avoirdupois.
Anthracite coal has a specific gravity of 1.5; and a cubic foot weighs	94
Antimonial copper, also called tetrahedrite or gray copper, from many localities in the United States, has a specific gravity of 5.0, and a cubic foot weighs	300
Antimonial silver, a mineral found abundantly in Mexico, Nevada, Hungary, etc., has a specific gravity of 9.5, and a cubic foot weighs	600
Antimony ore, the gray sulphuret, generally called the crude antimony, the substance used for producing the regulus, has a specific gravity of 4.5, and a cubic foot weighs	279

	Pounds Avoirdupois.
Antimony regulus, a metal imported from Europe for type-founders, has a specific gravity of 6.5, and a cubic foot weighs	400
Apatite, or phosphate of lime, used for the manufacture of super-phosphate, or artificial guano, and found in Canada, and lately in South Carolina, has a specific gravity of 3.0, and a cubic foot weighs	186
Arsenical iron pyrites, commonly called mispickel, a mineral widely diffused in the United States, contains about fifty per cent arsenic, has a specific gravity of 6.0, and a cubic foot weighs	370
Asbetus, a very useful mineral in the arts, has a specific gravity of 3.0, and a cubic foot weighs	186
Asphaltum, also called mineral pitch, has a specific gravity of 1.0, and a cubic foot weighs	62
Barytes, the sulphate of baryta, a useful substance for manufacturing purposes, has a specific gravity of 4.5, and a cubic foot weighs	310
Baryta carbonate, or Witherite, a mineral used in the manufacture of Blancfix has a specific gravity of 4.0, and a cubic foot weighs	248
Bismuth, a material of Babbit's metal, has a specific gravity of 9.7, and a cubic foot weighs	600
Bituminous coal is of light gravity, say 1.5, and a cubic foot weighs	90
Black lead, also called graphite, has specific gravity of 2.0, and a cubic foot weighs	125
Black Jack of the miners, but a blende, or sulphuret of zinc, has a specific gravity of 4.0, and a cubic foot weighs	250
Bog iron ore is an earthy iron ore, has a specific gravity of 4.0, and a cubic foot weighs	250
Brown hematite, a valuable iron ore, and abundant in the United States, has a specific gravity of 4.0, and a cubic foot weighs	250
Building stones, comprising granite, gneiss, syenite, etc., have a specific gravity of 3.0, and a cubic foot weighs	186
Calamine is a silicate of zinc, has a specific gravity of 3.3, and a cubic foot weighs	190
Chromic iron forms the base of chrome yellow and bicarbonate of potassa, has a specific gravity of 4.5, and a cubic foot weighs	260
Copper pyrites, a very abundant mineral, has a specific gravity of 4.0, and a cubic foot weighs	260
Derbyshire spar, or fluorspar, has a specific gravity of 3.0, and a cubic foot weighs	186
Feldspar, the base of porcelain, milky glass, etc., has a specific gravity of 3.0, and a cubic foot weighs	190
Flint, this mineral belongs to the quartz family, has a specific gravity of 2.5, and a cubic foot weighs	110
But the loose sand weighs, per cubic foot	95
Franklinite, a very valuable manganese iron ore, has a specific gravity of 5.0, and a cubic foot weighs	310

	Pounds Avoirdupois.
Galena, the common sulphuret of lead, used to produce pig lead, etc., has a specific gravity of 7.5, and a cubic foot weighs	465
Gold, specific gravity (twenty carats) 15.7, up to (pure) 19.2, and the average weight of a cubic foot............	1,000 to 1,200
Gypsum, or plaster of Paris, has a specific gravity of 2.3, and a cubic foot weighs..	130
Iron—cast iron, a cubic foot weighs..........................	450
Magnetic ore has a specific gravity of 5.0, and a cubic foot weighs..	310
Spathic ore has a specific gravity of 3.0, and a cubic foot weighs	200
Pyrites, or bisulphide of iron, has a specific gravity of 5.0, and a cubic foot weighs..................................	310
Pyrrhotine, or magnetic pyrites, or sulphuret, has a specific gravity of 4.5, and a cubic foot weighs	280
Specular iron ore, a very abundant ore, including the hematite, the calcareous and specular, as also the clay and jaspery iron ores, red hematite, has a specific gravity of 4.5, and a cubic foot weighs..	290
Wrought iron, a cubic foot weighs..........................	487
Limestone hydraulic has a specific gravity of 2.7, and a cubic foot weighs..	150
Magnesian, is now in great demand for producing very hard cement, specific gravity 2.5, and a cubic foot weighs	130
Manganese, binoxyde of, or pyrolusite, has a specific gravity of 4.8, and a cubic foot weighs	294
Bog or wad, an inferior quality of the above, has a specific gravity of 3.5, and a cubic foot weighs	217
Mountain copper, or malachite, or green carbonate of copper, an ornamental stone from Siberia, Australia, and United States, has a specific gravity of 4.0, and a cubic foot weighs	248
Muscovite, or mica, a mineral destined to be ever in much demand for the arts and large deposits of which are found in several States, has a specific gravity of 2.8, and a cubic foot weighs	160
Novaculite, or whetstone, a valuable mineral from Arkansas, North Carolina, etc., has a specific gravity of 3.0, and a cubic foot weighs	186
Ochre, extensive beds exist all over the United States ; the yellow and brown ochre have a specific gravity of 3.5, and a cubic foot weighs	217
Platinum, the specific gravity of the metal and ores is from 16 to 19, and a cubic foot weighs, on an average..............	1,116
Porcelain clay, commonly called China clay, distributed all over the United States, has a specific gravity of 2.0, and a cubic foot weighs..	140
Pyrites iron, or bisulphide of iron, pyrrhotine, or magnetic pyrites, a simple sulphide of iron, all have an average specific gravity of 4.5, and a cubic foot weighs....................	280

	Pounds Avoirdupois.
Quartz, the pure quartz, if compact, has a specific gravity of 2.6, and a cubic foot weighs	155
Trap, this useful rock, broken up for paving, has a specific gravity of 3.0, and a cubic foot weighs	186
Vitreo copper, or copper glance, a well known copper ore, has a specific gravity of 5.5, and a cubic foot weighs	314
Wood tin, or stream tin, has a specific gravity of 7.0, and a cubic foot weighs	434
Zinc—the sulphide or blende has a specific gravity of 4.0, and a cubic foot weighs	248
Zincite, or red zinc ore, has a specific gravity of 5.5, and a cubic foot weighs	331
Zinc carbonate, or Smithsonite, has a specific gravity of 4.4, and a cubic foot weighs	268
Zinc sillicate, or calamine, has a specific gravity of 3.4, and a cubic foot weighs	200

It may be added, for convenience of calculation, that twenty-seven cubic feet are equal to a cubic yard, and that forty cubic feet of articles, nearly equal to the specific gravity of water, are equal to one ton, while one ton of marble is equal to 13.07 cubic feet; granite, 13.05; common cobble stone, 14.22; paving stone, 14.83; sand, 23.05; grindstones, 17.00; brick, seventeen cubic feet.

On a future occasion, these tables will be more extended.

Many of the weights in the above table are calculated on sixty-two, instead of sixty-two and a half, as the weight of water. The results are theoretically inaccurate, but practically more correct for rough calculations or large masses.

Underground Railways.

The regular subject for discussion, viz., underground railways, was then taken up, and Dr. Bradley explained his plan of running a subterranean railway from one end of New York city to the other, which plan involves the construction of a tunnel in a straight line and under the blocks of buildings from South Ferry to Harlem Bridge. The doctor proposed to have the work of excavation proceed simultaneously at short intervals, and believed that with suitable means and appliances the whole could be completed in the short space of six months. Stationary engines would be erected at the intervals to operate the excavating and dirt-carrying machinery, and after the completion of the way could be employed to operate elevators for raising and lowering passengers.

Mr. Gardener introduced the so-called arcade plan in a fluent

speech, which was rather a specimen of special pleading in behalf of this particular scheme than an exposition of any mechanical or engineering principles involved. The plan may be briefly stated to contemplate the excavation of Broadway to a depth of about seventeen feet, and then to replace the roadway as it now exists by a firm and solid bridge, a new street being thus formed underneath the roadway. At the sides of the roadway will be left an area of five feet as now, protected by railings, and open except in front of doors, and at each block circular stairways will lead to the lower street. The sidewalks are to be relaid as now, except that next to the street patent lights will be placed to the width of four feet along the line of the street, which, with the areas, will give sufficient light to read in the cars with ease. The five-feet areas at each side and the cross ventilation procured at the cross streets are expected to give abundance of air.

The lower street, resting on the solid earth, will be devoted to the railroad and two sidewalks. The sewers, and water, and gas pipes will be placed just beneath the surface of the lower street, and may thus be reached at any time without the trouble of digging now experienced. The water and mud of the upper street will run into the sewers through the hollow columns.

With four tracks, the two inside ones are to be used for rapid trains to accomodate through travel, going from the Battery to Harlem in about thirty minutes; and the outside tracks, next to the sidewalks, for slower cars, stopping as often as may be desired to accomodate way travel. The inside trains running with great rapidity and the outside cars running at as short intervals as necessary, with the two branches from Union square, are expected to accomodate all the travel that will offer for many years.

After deciding to resume this discussion the association adjourned.

May 28, 1868.

Professor S. D. Tillman, Chairman.

The following notes on new discoveries and inventions were presented by the Chairman:

The Durometer.

The instrument for testing the hardness of metals by drilling is the invention of M. Behrens, an Engineer of Tarbes in France. It has

been thoroughly tried, and it is said that many French contracts for rails now contain a condition that they are to be tested by this apparatus. It consists of an upright cast iron standard bolted down upon a bed-plate, and provided with a table for supporting the rail or other article to be tested. The spindle of the drilling tool is capable of being raised and lowered in its bearings by turning a handle for that purpose, and the drill is held down to its mark by a weight fitted to the upper end of the drilling spindle. Its rotary motion is derived, through a pair of miter wheels, from a driving shaft carrying the usual fast and loose pulleys. This shaft has a worm upon it which moves a train of mechanism, in connection with a signal gong, for the purpose of indicating the number of revolutions made by the drill. The apparatus is exceedingly compact. Its use by French manufacturers has led to a gradual increase in the hardness of the rails they produce.

THE CORAL KEYS.

In a paper read to the London Society of Engineers by Dr. Cullen, "On the Isthmus of Darien and the Ship Canal," the author, in describing the Atlantic coast, says: "The coral of the cays and islands is exceedingly beautiful. When living in their natural element, the various sorts of coral are covered with a gelatinous matter of the finest colors; and, looking out of a boat on a sunny day on the groves of coral sea-fans, sponges and polypi, with their brilliant colors dancing on the unsteady water, and gaudy fish gliding about among their branches, one can imagine himself looking through some brilliant kaleidoscope. Immense lobsters, conches, and whelks the size of a man's fist, are found in abundance at these coral cays, and also a large crab about the size of a soup plate, with a lovely pink shell spotted with white. Hermit crabs roam at night over these little islands, disturbing the weary boatmen by biting their toes, and demolishing any kind of food in the pots; during the day they all disappear, being snugly hid under the tufts of grass. In the quiet bays, protected by the coral reefs from the trembling breakers, flocks of grave pelicans sail about on the water, with their heads thrown back, and their long bills resting on their breasts, or tumble headlong from the air among the shoals of sprats, driving them in a silver shower out of the water. The predacious frigate-bird pursues the snowy sea-gull, screaming, round the cay, and amusing the spectator with its maneuvers to escape, till, wearied out, it lets fall the coveted fish, which is seized by the other before it reaches the water. Along the glaring sandy

beach parties of snipes and sand pipers scamper in pursuit of their prey, which is washed up in the rolls of sea-weed by the little waves. Now and then, as a boat passes, yellow water-snakes will suddenly erect their heads and show their fangs with an angry hissing. Occasionally, shoals of grampus enliven the scene, splashing, leaping and hunting one another with the greatest liveliness. The white, calm bay, with its background of rich evergreen foliage, and the light feathery clouds drifting over with the steady trade wind, form a *coup d'œil* only to be imagined in the dark and stormy north."

Mirage.

The rare optical phenomenon known as mirage consists in the apparent displacement of objects in the vicinity of broad sheets of water or over sandy plains, and is due to the refraction of light. Air in contact with a heated portion of the earth's surface becomes dilated; therefore in sustaining the weight of the incumbent atmosphere its elasticity is increased, while its density is diminished. Adjacent layers of air of different densities have different refracting powers, and rays of light coming with great obliquity from a distant object before reaching the earth are thus bent upward, and present to the observer the impression of light reflected from the surface of water; and where such object is over water, both the light directly from it and that of its reflection reach the eye at the same instant, by which two images are seen opposite one to the other, and joined at their bases. This class of phenomena must not be confounded with that due to the reflection of terrestrial objects on the clouds, distinguished as spectra. Mirage is visible near the horizon, and when the object is not far off is seen more distinctly as the eye approaches the ground. Many details of mirage which escape the naked eye may be revealed by the telescope. The contrasts of temperature producing mirage occur frequently in the artic regions when the summer sun acts powerfully on masses of ice; in milder climates such contrasts are rare. When strata of air of different density extend vertically, instead of horizontally, by means of strong currents, it would be inferred that the object will appear at right angles to its true position, and such has been proved by observation to be the fact. Lateral mirages have been seen on Lake Geneva, Switzerland. In these phenomena of refraction, the distance from the observer to the actual position of the objects represented seldom exceed ten or fifteen miles. A very remarkable case occurred on the 15th of April, at

Batavia, which is by rail thirty-seven miles from the foot of Lake Erie, and is thus described by a correspondent of *Rochester Union:* "While we were admiring a golden sunset (the eastern horizon at the same time arched by the bow of promise), the waters of Lake Erie rose upon our vision in a mirage so perfect and brilliant that it was difficult to believe that we were not in the region of enchantment. The phenomenon in its full brilliancy lasted about half an hour. It was witnessed by several citizens in Buffalo. At one time eleven vessels were distinctly visible, even a steam tug was seen, with steam issuing from the smoke-stack. Large bodies of ice covering what appeared to be several acres, each were seen openly floating toward the source of the Niagara. The Buffalo gentlemen were naturally enthusiastic, and declared that they had never seen the lake of their pride exhibit itself in more natural habiliments, not even from their Rialto, yclept, the docks. The mirage above described was remarkable for its great strength."

In relation to this item read by the chairman, Gen. E. M. Barnum said: When the Pacific railroad is completed, the people will have an opportunity of witnessing the most wonderful mirage known. That portion of the continent lying between the great Salt lake and Sierra Nevada mountains, the eastern boundary of California, is a continued succession of hills, running north and south. The appearance of the mirage here is exceedingly grand. He had often noticed its peculiar effects on the thirsty and foot-sore animals. The lake in the distance seemed so natural that the animals if left to themselves to move of their own accord, would often travel some fifty miles; they would start themselves towards the mirage. This is probably the most beautiful mirage on this continent.

Dr. J. V. C. Smith remarked that he had seen the mirage on the desert of Arabia, and the camels were as much deceived by it as he himself was, and this occurred day after day. This was on the Hadjii route.

ALAZARINE.

Taking advantage of M. Schutzenberger's investigation of madder, which was proved to contain five pigments, M. Martin has lately perfected and patented in France a process for transforming four of them into the only one (alazarine) yielding an unalterable dye. The several coloring matters are first dissolved in concentrated sulphuric acid, and then zinc is added. The reaction is accelerated by the use of

powdered zinc and the application of heat; when it is completed, the mass is diluted with water, and the abundant precipitate is the required dye, which, after being washed with water, is ready for use. Thus orange-madder, purpurine, pseudo-purpurine and Xanthro-purpurine are transformed into alazarine. This process for making available all the coloring matter in madder seems to be important in a pecuniary, as well as scientific, point of view.

A Remarkable Mineral Spring.

The water of a medicinal spring on the Island of Jamaica has been analyzed by Dr. Attfield, of London, and found to contain a larger quantity of chloride of calcium than any other natural water now known. It is clear, inodorous, and strongly alkaline to the taste. One gallon of it holds in solution about three and a half ounces of chloride of calcium, two ounces of common salt, and two and a half grains of chloride of ammonium. It has been used for medicinal purposes by the negroes of the island for the last forty years, and has been found most beneficial in scrofulous diseases, glandular swellings, etc. The spring is sixty-eight feet above the sea, and nearly a mile from it, rising through a diluvial gravel that forms the bed of a small stream near Saint Ann's, on the northern coast.

Sirius.

Mr. C. Abbe, of the Pulkova Observatory, has, by means of the meridianal observations of Sirius, made with the transit circle at the Cape of Good Hope, adduced a parallax lying between thirty-seven and seventeen one-hundredths of a second. The brightness of Sirius, it being four times greater than that of any other fixed star visible in the northern hemisphere, would lead us to expect a greater difference in the directions of the telescope when upon that star at opposite points in the earth's orbit, 190,000,000 miles apart; and, at any rate. that the parallax might be determined with a less probable error than has been assigned by Peters to several stars of inferior magnitude. According to Abbe, the distance of the dog star is not less than 563,000 times the diameter of the earth's orbit, or greater than 1,224,000 times that diameter. Taking the least sum as the true distance, some faint conception may be formed of its vastness by the statement that an object moving as fast as the earth rotates at the equator, or 1,000 miles an hour, would require more than 12,200,000 years to pass from our planet to Sirius.

DECOMPOSITION AND RECOMPOSITION OF LIGHT.

Mr. W. J. Lane used, in place of the costly apparatus generally employed for this beautiful and instructive experiment, a glass tube eight or ten inches long and half an inch in diameter, with a bore of .05 to .09 of an inch. In a room containing only one light (a gas flame, for instance), while standing a few feet from and facing it, place the tube horizontally across the eyes and as near to them as possible, and, on looking toward the light, a beautiful arc of large size will appear, which is composed of a series of splendid spectra, more or less brilliant, according to the refractive powers of the tube and the distance of the observer from the light. Now, upon revolving the tube, while so placed, the arc of light will apparently revolve very rapidly, the colors will be blended and *white* light produced; thus affording a pleasing experiment. With large tubes of greater dispensive power the effect would probably be more beautiful.

NEW AIR COMPRESSING PUMP.

Mr. Onofrio Abruzzo, late of Italy, exhibited his patent pump for compressing air, described as consisting "in arranging a series of vessels and providing each one with a pumping apparatus. When the apparatus of the first pump is set in motion, it will compress the air in all the vessels to a certain degree, according to the power of the pumping apparatus and to the rapport between the two volumes of air contained below the piston at the end of its upward and downward strokes, which volume determines the compressing power of the pumps. If the volume below the piston, when the same is at its lowest stroke, is, for instance, the twentieth part of that volume which is below the piston at the end of its upward stroke, the pump will be able to compress twenty times the former volume at each stroke. When all the vessels are filled with such compressed air, the apparatus of the second vessel is set in motion and compresses the air in all the vessels except the first." A brief discussion upon the merits of this invention followed the inventor's explanation of its working.

Dr. N. H. Barbour stated that he had constructed three pumps similar to the one described, at the Morgan Iron Works in this city. They are used for compressing carbonic acid gas, by which a pressure of 1,500 pounds to the square inch can be obtained.

Mr. C. E. Emory remarked that what is desirable in a good pump is to have the space between the piston head and cylinder as small as possible. The best pumps are made with the clearance between the

piston and cylinder head to be nearly in contact, and even this space is filled with water so as to bring them still closer together.

Underground City Railways.

The discussion of this question was resumed. Mr. Gardener was accorded the floor and occupied some considerable time in a repetition of his remarks made at the meeting of the previous week, and then, by the aid of drawings, illustrated the means which it is designed to employ to prevent any material interruption of travel on Broadway during the operation of constructing the Arcade railway, the apparatus consisting in a sectional bridge, apparently intended to be placed over the excavation while the work therein is in progress. The question of the deleterious effects of the gases from the locomotive being called up, Mr. Emory stated that in his opinion no steam locomotive could be employed to advantage in an underground railway.

After Mr. Gardener had finished the elucidation of his ideas relative to the Arcade plan, Mr. Barnum, in a style no less diffuse, set forth his project of an elevated railway, taking the ground that the city railways should be built, not on Broadway, but on the avenues, in order to better accommodate the great mass of the population. His idea appeared to include the use of corrugated wrought iron posts, supported upon cast iron bedsills buried in the ground, the columns being provided at the top with iron crossheads, having placed upon them the wooden crossties to which the rails are to be secured; there being, furthermore, pads of india rubber interposed between the crossheads and the ties. In addition to this, Mr. Barnum proposed to have a pneumatic tube arranged between the rails for purposes of postal dispatch, and claimed, as some of the advantages pertaining to his mode of construction, that the supporting posts would furnish a very convenient means of suspending signs and awnings.

After agreeing to resume the question, the association adjourned.

June 4, 1868.

Prof. Tillman said the President of the Institute, the Hon. Horace Greeley, had consented to occupy the chair during the reading and discussion of the usual summary of scientific news. Mr. Greeley assumed the duties of presiding officer with the evident approbation

of a very large audience. Prof. Tillman then read the following notes on science.

NEW ELECTORAL PHENOMENON.

H. Poggendorff has described a new experiment made by him with a Holtz machine for generating electricity. A glass tube, from which the air had been exhausted as completely as possible, is partly filled with mercury. The ends of the tube, being previously coated with tin-foil, are bent at right angles, so that when the main part of the tube, about a foot in length, is horizontal, the platinum wire entering at each end will not come in contact with the mercury. Thus prepared, the tube is hung between the electrodes of the machines, so as to be perfectly horizontal; when the machine is set in motion, the mercury thus isolated in the tube is seen to travel from the negative to the positive pole. The thread of mercury was about four inches in length, and moved over a space of eight inches in from two to three seconds, elongating itself during the action about one inch. The quantity of mercury used was about one ounce; a smaller amount of metal could not be made to move.

A FRAGRANT SUBSTANCE FROM RESIN.

Mr. W. Skey has published the following: Common resin, lac or Kauri gum, in a state of powder, is gently heated with dilute nitric acid for a few hours; the mixture, or solution, as the case may be, is then evaporated to dryness, or nearly so, and treated with an excess of a strong solution of common soda, caustic potash, and lime in water; the resulting liquid is then transferred to a retort and distilled. At first the distillate has an odor of garlic, but this gradually gives way to an odor decidedly fragrant. On redistilling the portion last drawn over from concentrated sulphuric acid, a strong aqueous solution of this odorous substance is obtained, the solution itself has a warm aromatic flavor, and odor assimilates to that of peppermint mixed with lavender. Bichromate of potash with sulphuric acid, also, may be used for the oxydation resin employed.

OXYDATION OF AMYLIC ALCOHOL.

The following statement is made by A. Claus. Amylic alcohol, nitric acid having a specific gravity of 1.5, and water, were placed in a cylinder without being mixed. After the lapse of four months the smell of alcohol disappeared, that of amylic valerianate being substi-

tuted. The fluid was then diluted with water, and one-half of it distilled; the distillate was found to consist chiefly of ether. The residue, on further concentration, gave off nitric acid vapor, and, on cooling, crystals of oxalic acid were separated.

Improvement in Distillation.

The troublesome "bumping" peculiar to certain liquids may be prevented by a device described by P. Pellogio. A glass tube as large as practicable is inserted in the tubulus, reaching nearly to the bottom of the retort. The upper end of the tube is bent at right angles, and drawn out to nearly capillary size, through which communication is established between the outer air and the interior of the retort. By this means methylic alcohol, sulphuric acid, petroleum residues, and other liquids may be distilled as regularly as water.

Ventilation of Stock Sheds.

Mr. Mechi, the well-known English agriculturist, says on this subject: "When farmers see my twenty bullocks in one covered and inclosed shed, they frequently exclaim, 'Can they be healthy here?' That is a very proper remark, for unless the ventilation were perfect, they could not be healthy so closely packed in a limited space. As my system of ventilation appears to keep my animals (although closely packed) in perfect health, I will describe it. A portion of the center of the roof is raised above the rest, with louver-boards on each side; but the wind is not allowed to blow through from one side to the other, for a board, a yard or more in depth, is dependent from the roof, so that the current of air coming through the louver-boards is deflected and passes downward, driving the foul air through the opposite side or louver-boards, or through the holes in the top of the walls under the wall plate. The circulation, thus constant and perfect, was seen by means of steam which otherwise could only have been surmised. In sheds where two bullocks only occupied twelve by eight feet, for twenty years there has not been the loss of an animal, although many lots have been fattened there, some remaining from calves until two years old."

Steam Road-Roller.

The town council of Sheffield, England, has put in use a steam roller for smoothing newly graded streets. It consists of four wheels or rollers, each two feet wide. The two front wheels are placed three

feet six inches apart, the principal part of the driving machinery being between. The hind wheels run close together and overlap a little, so that the total width covered is seven feet six inches. Power is communicated to the front wheels by an improved endless chain of great strength. The machine is steered by means of the hind wheels, which are fitted in a turntable; it can be turned around with great ease within a circle thirty feet in diameter, but as the rollers work equally well in moving backward or forward, it is seldom necessary to turn the machine. It weighs twenty-five tons, and was purchased from Messrs. Aveling and Portern, London, at a cost of $4,500. After passing two or three times over a rough and almost impassable thoroughfare, the machine converted it into a smooth and level road. A similar engine, but much heavier, is in successful operation at Liverpool.

A NOVEL THERMOMETER.

Dr. J. P. Joule has constructed a thermometer on a new principle. It consists of a copper tube surrounding another tube having a hinged bottom. Within the smaller tube which is open at the top, is a fine wire having a spiral form and suspended by a silk thread, upon which a small mirror is fastened so as to turn with the thread. When the bottom is closed, the mirror reflects a light, so as to mark zero on a graduated scale; but when open, the air inside the tube being warmer than that outside of the apparatus, a current is established which, by means of the spiral wire, twists the silk thread. A difference of one degree Fahrenheit between the inside and outside air produces a current sufficient to cause a complete turn of the thread. The elevation of temperature within the tube is, according to the views of the author, produced by the absorption of heat by the copper tube, which is radiated internally. It is evident this apparatus cannot be used out of doors on a windy day, or even in a room in which currents of air are moving.

DIFFERENTIAL SATUROMETER.

This instrument, invented and lately patented by M. Coret, is an attachment to the boilers of steamships in which steam is made from seawater, intended to indicate the degree of saturation, and at the same time record the level of the water in the boiler. The action of the instrument depends on the well-known principle that when two different liquids, having the same temperature and no chemical affinity, are placed in an inverted syphon, their heights in each

column, under the condition of equilibrium, will be inversely as their densities. Two glass tubes, communicating with each other at the bottom, are placed side by side with a graduated scale between them. One tube is connected with the feed-water, and the other with the water in the boiler; so arranged that when the comparison is to be made the connections are cut off. It is said the accuracy of this apparatus permits a nearer approach to the point of saturation than formerly, thus obviating the difficulties and loss of heat arising from a too frequent extraction of the saline deposits from the boiler.

Mica Spectacles.

A device, simple for the protection of the eyes of persons engaged in working metals, is one of the results of an investigation by Dr. H. Cohn, an occulist of Breslau. His inquiries extended to six manufacturing establishments, embracing 599 fitters, 386 blacksmiths, 129 turners, thirty-five drillers, thirteen planers, twenty-seven engine-wrights, five screwers, fifteen boiler-makers, sixty-nine founderymen, eight cleaners of castings; total, 1,283. He found that ninety per cent of the workmen had often been injured on the eye by minute pieces of metal, and that forty-nine per cent had been under medical treatment for serious accidents to their eyes. Of the whole number, fifty-nine were found to be permanently injured, and twenty-one of those had each lost the use of one eye. The whole time lost by the workmen from accidents to the eye amounted to 4,726 working days. No protection to the eye had been provided. Ordinary glass spectacles were objected to on account of their liability to be broken. At the suggestion of Dr. Cohn mica spectacles were tried, and found to fulfill all the requirements. The mica used is of the purest kind, about half a millimeter in thickness, and is curved somewhat like watch glass. It is held in a frame which fits close to the side of the eye, so as to prevent the entrance of particles on either side. Mica imparts a pale grey tint to objects, but does not impair the eye. Its toughness, elasticity and transparency admirably adapt it to the protection of the eyes of metal workers. The price of a pair of mica spectacles at Breslau is about fifteen cents.

Process for Bleaching Palm Oil.

M. Engelhardt, of Leipzig, rapidly bleaches palm oil in the following manner: The oil is heated in a cauldron to about 144 degrees Fahr., and allowed to remain during one night. On the following day

it is poured into a clean vessel and cooled down to 104 degrees or 100 degrees Fahr. In the meantime a quantity of water is brought to the boiling point, and in forty-five parts of it by weight, fifteen parts of bichromate of potash are dissolved. When the solution has cooled a little, sixty parts of hydrochloric acid are added and then the palm oil is poured in, the whole being well stirred during the process of mixing, and still continued until the oxyd of chromium becomes completely separated. The oil assumes, within a few minutes, a dull green color, but gradually becomes clearer, and is finally quite limpid. On being washed in hot water, the product is usually white, but if found to be not thoroughly bleached, the process is repeated with twenty-three parts of bichromate of potash, and one part of hydrochloric acid.

IMPROVED ASPIRATOR.

The apparatus used in the laboratory for drawing gases through liquids by means of a discharge of water from the bottom of a closed jar or bottle which is connected at the top with a pipe conveying the gases, has been modified in form by Prof. A. R. Leeds of Haverford College, Pa., so as to apply the principle of drawing one current by means of another. A water pail is so arranged on a table as to discharge it's contents into a bucket on the floor by means of a stop cock and tube; on the top, and in front of the stop cock, is inserted a vertical tube connected by India rubber tubing with a wash-bottle or other vessel through which it is to be drawn. When the stop cock is partially opened the descending water draws with it a current of gas, somewhat as air was carried into tuyeres by the water tromp formerly used in furnaces for reducing iron ore.

CURCULIO.

Experiments made by Benjamin D. Walsh, acting State entomologist of Illinois, have led him to the conclusion that there are two distinct broods of the plum curculio every year, the first of which comes out in the beetle state in the latitude of Rock Island, from about July 19 to August 4, and the second from August 23 to September 28. The first brood is generated by females that have passed the winter in the beetle state, and have attacked the early fruit, laying in the more matured fruit the egg from which proceeds the second brood. The second brood of beetles come out late in the same season, and the females, at all events, if not the males, live through

the winter, and repeat in the succeeding season the process detailed above. Thus it will be seen at once, the curculio differs from the apple-worm or codling moth, which is also double-brooded, in this, that the former passes the winter in the perfect state and the latter in the larva and pupa states. The practical inference to be drawn from this discovery is that by destroying in June or early in July the first wormy fruit that produces the first brood, the crop of curculios for the current year is diminished. No reliable method for driving off the curculios has yet been discovered. It is proper to here state that Dr. Trimble, entomologist of the State of New Jersey, has made experiments in relation to the production of distinct broods. He has taken the earliest curculio of the season and watched their movements. He has never been able to discover embryo eggs in the females until the next spring, and never has he seen the sexes approach each other during the first season of their maturity. Like many other insects, curculios do not increase their number until the second year. They hybernate during the intervening winter. Further experiments should be made to finally settle this question.

A Constant Single Liquid Battery.

More than 20,000 elements of Leclanché's peroxyd of manganese battery are now in use on telegraphs connected with the French and other European railways. Twenty-eight of these elements have been found equal in practice to a series of forty elements in a Daniel battery. As peroxyd of manganese has considerable conductability, resembling in this respect the metals, Leclanché was led to use it as the positive element in connection with zinc as the negative. After various tests of solutions of different salts he decided to employ, as the liquid, a concentrated solution of salt of ammonia, the sal ammoniac of commerce being preferred. He uses the black and brilliant peroxyd of manganese in the form of large grains, mixed with an equal quantity of powdered carbon in a porous jar. The electricity obtained is collected and used by means of a carbon plate. In preparing this battery, care should be taken that the solution does not rise more than half way up the porous vase, as the drier its contents are the better is the condition for working.

Air Tight Galvanic Battery.

C. T. and J. N. Chester have constructed a very compact and powerful battery for medical uses which has the merit of being always

ready for use. It consists of a series of glass cells, each three inches long and one inch in diameter, inserted in a wooden block; a zinc cover is provided for each glass, and a projection from this zinc cover into the glass forms the zinc element. The other element is carbon, carefully connected with platinum, and well insulated from the zinc cover. A plate of soft rubber is interposed between the zinc cover and the glass top, and the packing is made completely air tight and water tight by the pressure of two rubber straps, extending from the cover to the base board. Connection between each two cells is made by short pieces of spiral springs. The battery is charged by filling the glasses half full of water, adding some bisulphate of mercury, and a little shred of cloth is interposed between the plates, so as to retain moisture. When the battery is to be used it is inverted, thus throwing the fluid into the opposite end of the glass vials, overflowing the elements and saturating the piece of cloth. On restoring the battery to its proper position, the fluid leaves the plates, with the exception of the minute portion retained by the cloth, which, however, is sufficient to excite powerful intensity currents, producing violent muscular contractions, even forty-eight hours after this immersion of the plates. A single drop of fluid being thus efficient, the constructors believe their battery, once charged, would last a year or more for giving occasional effects. A modification of this arrangement is made by inserting a tube to carry off the gas formed by decomposition, when a fluid of greater energy is used. The battery can be completely renewed at the rate of fifty cells in one hour; and 150 cells exceed in intensity 100 cells of the Grove battery. In the arrangement first described, no acid is used, and no gas generated. When great intensity is required this battery will be found less troublesome and more convenient than many of the ordinary forms.

VENTILATION OF PUBLIC BUILDINGS.

In a paper read by Gen. Morin, director of the Imperial Conservatory of Arts and Trades, before a meeting of mechanical engineers, in Paris, the opinion is expressed that the different arrangements for getting rid of vitiated air and replacing it by fresh air by means of suction, when well proportioned and well carried out, are more effectual than those which depend exclusively on blowing in fresh air, as the latter do not, in every instance, and at all times, insure the vitiated air being uniformly and continuously expelled. The

quantity of fresh air required, whatever may be the height from which it has to be drawn, and whatever the quantity, can be obtained by suction alone, and without the aid of any blowing apparatus, by giving to the inlet openings for the fresh air sufficiently large dimensions, and placing them in suitable positions. Suctions can be easily obtained either by means of open fireplaces with chimneys, or similar heating apparatus, or by means of special fireplaces placed at the bottom of the exhausting flues, and acting as auxiliaries when the rooms are large. The air to be removed ought to flow toward the bottom of these fireplaces, and, whenever possible, by means of special air-flues leading from openings close to the sources of ventilation. Ventilation by suction through fireplaces and chimneys can be adapted to the proportions and arrangements of every kind of room, as it resembles the ordinary and natural ventilation of rooms, and the volume and temperature of the fresh air can be varied as required. It is only necessary to construct at small expense fireplaces with thin chimneys and air-flues, which, when completed, cost but little for repairs, and to supply the fireplaces with fuel, which any common attendant is competent to do. On the contrary, ventilation by means of blowing and other mechanical apparatus, necessitates, beside the flues and chimneys common to both systems, the addition of blowing machines and engines with special air-passages, special artisans, engineers, and firemen, and involves an extra cost for keeping up. Besides this system does not afford the same guarantee as that of suction, against difference of vitiated air, especially in hospitals several stories in height, where it may pass from one room into another through the openings of the discharging flues, when it happens that the pressure and movement of the air of a room are disturbed by the openings of doors or windows. There may be special cases where it would be advantageous to use mechanical apparatus in connection with suction; for instance, where the quantities of air to be removed differ greatly from one day and from one hour to another, as in the case of St. George's Hall, Liverpool, in which mechanical ventilation exclusively is used, and the quantity of air required varies in the extreme proportion of one to fifty. The following proportions for the quantity of air required to be supplied *per hour for each person* are based on the results of a large number of experiments by different observers, and although larger than the rates formerly adopted, are not, in Gen. Morin's opinion, at all exaggerated:

	Cubic feet.
Schools, for each child, per hour	400 to 500
Schools, for each adult, per hour	800 to 1,000
Meeting halls, for each person, per hour	1,000 to 2,000
Theatres, for each person, per hour	1,400 to 1,700
Prisons, for each person, per hour	1,700
Workshops, ordinary trades, per hour	2,000
Workshops, unhealthy trades, per hour	3,500
Ordinary hospitals, per hour	2,000 to 2,400
Hospitals for epidemic cases	5,000

The temperature of the air in places abundantly ventilated, and having a continual renewal of air, can be maintained at a higher point than in rooms not well ventilated; but, as a general rule, the temperature should not exceed the degrees here given (without fractions, on both the Fahrenheit and Centigrade thermometer).

	Fahrenheit.		Centigrade.
Workshops	59,	or	15
Hospitals	61 to 64,	or	16 to 18
Schools	66 to 68,	or	19 to 20
Meeting rooms	66 to 72,	or	19 to 22
Theatres	68 to 72,	or	20 to 22

The fresh air supplied should be at nearly the same temperature as the one to be maintained in the room; but if there is a large cooling surface of glass in windows, it has to be increased to as high as eighty-five degrees to ninety-five degrees Fahrenheit (thirty-six degrees to thirty-five degrees Centigrade), or diminished where the room is partially heated by a large number of artificial lights, or by presence of a large concourse of persons. For the purpose of regulating the temperature, the supplied air, warmed by some heating apparatus, has to be received first into a chamber into which cold air can be introduced for mixing with it. It has been found, by practice as well as by theory, that the average velocity of air in the flue is proportional to the square root of the height of the chimney, and the square root of the excess of the temperature of the air in the flue over that of the external air; having the area of the chimney, it is easy to estimate the volume of air extracted.

The position of the openings for the admission and removal of the air is a point of great importance. None of these should be on a level with the floor where they would be obstructed by sweepings and rubbish. All the openings for the admission of air, whether warm or cold, should be placed near the ceiling, or at such height that no person may receive the impression of a draft. Openings for

the abstraction of air should, on the contrary, be placed generally in the lower part of the room.

The velocity of the vitiated air, in its passage outward, should continually increase through the several passages of the building, which is best effected by the use of a single shaft. On its entrance the air should move about three feet per second, and at its exit about six feet. An excess of seventy to eighty degrees Fahrenheit, in the temperature of the discharging shaft over that of the external air, will, in most cases, produce the required increase of speed; but in theatres, where the passages for air must be complicated, a difference of temperature of ninety-five to one hundred and five degrees Fahrenheit is required to effect the desired result. When the supply openings are on the side of the room at a considerable height, the velocity of the entering air may be as high as one metre (thirty-three inches) per second, without causing inconvenience; but when such openings are in the ceiling so that the air descends vertically, its velocity should not be more than half that just stated.

The suction system has been objected to for causing strong drafts when an outside door is opened, but this may be obviated by adopting suitable proportions and by warming the ante rooms and passages leading out of the building. The chimneys of dwellings will generally produce sufficient ventilation, even when there are no fires, on account of the ordinary difference in the temperature within and without. However, this ventilating power may be easily increased by introducing into the chimney a vertical pipe containing a few gas burners. In answer to a query whether it had been found essential to introduce moisture with the air supplied, Gen. Morin remarked that in the plan of heating adopted by him, a small portion of heated air was mixed with the cold air, and it was found there was moisture enough to prevent any sensation of dryness in the air when breathed. In reply to an inquiry whether the system described would answer for ventilating in hot countries where it would be required to cool the supply of fresh air, or whether the points of admitting or discharging air would in that case have to be reversed, Gen. Morin said the Lecture Theatre of the Conservatoire, in which they were then assembled, was ventilated upon the plan described in his paper, and it was found in practice that the room could be cooled, in warm weather, more readily by drawing off the vitiated air near the floor and admitting fresh air brought from below near the ceiling. In very hot countries it might be found essential to have recourse to a fine spray of

water, just sufficient to moisten the surface over which the fresh air had to pass on its way into a room, so as to bring into play the effect of rapid evaporation. All the details of the plans, as applied in the Public School, Rue des Petits Hotels, in the Theatre Lyrique, and in the Conservatoire, were exhibited and explained by the speaker. The uniformity of temperature in the Theatre Lyrique was a striking result. At a trial in November, when the temperature without was four degrees C., on the stage was nineteen degrees, in the orchestra stalls, twenty-one degrees, in the boxes twenty-three degrees, and in the gallery twenty-three degrees 5 C. This system of ventilation was highly commended by the speaker who followed Gen. Morin.

The article which elicited most discussion was the suction system of ventilation, as advocated by Gen. Morin, director of the *Covservatoire des Arts Metiers*, Paris. The economy of the suction system as compared with that of forcing fresh air into rooms by means of blowing apparatus was very fully set forth. The amount of fresh air required for each person per hour, in schools, workshops, prisons, hospitals and theatres was stated, also the temperature at which the air should be maintained in each kind of building.

Dr. Warren Rowell gave an amusing description of his experience in a badly ventilated public house. A number of practical questions touching ventilation were raised, and at the close of the debate Mr. Greeley said previous engagement compelled him to retire, and Prof. Tillman assumed the duties of the chair.

HUSSEY'S UNIVERSAL POSTAL SCALE.

Mr. Hussey exhibited his invention, and explained its importance as follows:

The want of a postal scale that would quickly determine the amount of postage required, to promote accuracy and speed in the transmission of postal matter to all parts of the world, has long been felt by the commercial community.

It has been the experience of nearly every person having domestic, as well as foreign correspondence through the various posts, that delays and loss of letters in most all instances are occasioned by ignorance and carelessness in posting communications. Hence the abuse usually heaped upon the heads of postmasters and their attachees for (as we think) neglect of duty, when, really, the whole fault lies at our own desks. We should *post ourselves* before attempting to post our letters, if we expect them to reach their destination

in proper time, if at all, and save the postal department thousands of unneccessary questions and ourselves much valuable time in obtaining answers.

One department rule is that if a letter is not prepaid, when prepayment is required, the letter or package goes direct to the dead letter office. Through the French mails, if the postage on a letter is not fully paid, the amount paid is forfeited. A little ignorance, a little miscalculation, or a little carelessness on our part gives us weeks and often months of disappointment and much pecuniary loss.

To obviate the above difficulties, we often fall into another, by stamping our communications with double the amount necessary for transmission, which is a small amount as to one letter, but in time shows an amount that would surprise and cause us to look seriously for its remedy.

Again, we should know by what route we may send our packages with least expense. This point is also seen to be of importance, when we state that there are four different mail routes to China, as follows:

For a letter package weighing eight ounces the postage is,

Via American packet via San Francisco	$1 60
" British mail via Southampton	5 44
" " " Marseilles	6 72
" French mail	9 60

Making a difference of eight dollars on the package to the same point.

This example is not an isolated one, but in nearly every foreign country with which we have postal relations the prices will be found to vary as in the above illustration.

It has been the inventor's careful study to produce a simple and substantial scale that would remedy all of these difficulties; so simple in its construction, and so complete in its workings, that none need err in the transmission of their postal communications.

We will not attempt, at this time, to give a full description of the scale, but enough to show the great advantages claimed for it over the common scales now in use for postal purposes.

All parts of the world with which we have postal relations are alphabetically arranged upon a metallic disc of twelve inches in diameter, with the various postal routes by which such post is reached, and then the exact sum of money necessary for the transmission of any letter, newspaper, printed or other mailable matter, weighing

from one-quarter to eight ounces, is pointed out by the indicator and the revolving of the disc. No calculation is required.

It also informs you, in all instances, where prepayment of letters is required, as well as all other important postal information. The inaccuracies encountered hitherto in the spiral spring scales are obviated in this invention by the adjustable indicator, which shows absolutely and at all times the least derangement in the scale, which can be easily remedied by reference to the directions upon the back of each disc.

As often as required to meet the changes in the postal charges, a new sheet will be printed and supplied to the purchaser at a moderate charge.

CARPET CLEANING MACHINE.

Mr. John R. Ferguson then exhibited and explained his carpet cleaning machine. It was so arranged that the carpet of any common room, in moving over rollers, was beaten thoroughly by two series of wooden arms arranged opposite to each other. A long box was placed underneath, in which a spray of water played, so as to arrest and settle the falling dust.

WOODBURY'S STREET LOCOMOTIVE CAR.

Mr. Whiting, a prominent patent lawyer of Boston, Mass., exhibited and explained for the inventor, Joseph P. Woodbury's patent street locomotive car, and gave reasons for the following points of superiority claimed for this invention:

1. The street steam car seldom gets out of order or needs repairs.
2. It will seat forty passengers, and can carry over 100.
3. It will run 100 miles per day, at a cost for fuel, oil, conductor and engineer, not exceeding eight dollars, being less than one-half the expense of doing the same work with horses.
4. It will run easily around curves of thirty feet radius, and less, if required; without abrasion of the rail, such as is produced by all other cars.
5. It will not frighten horses, or make objectionable noise more than horse cars; the machinery being out of view, and there being no toothed gears, bell or whistle, and no puffing noise, or visible escape from the exhaust steam.
6. It is as safe, easy and comfortable as the long cars on steam railways; it is warmed by steam when needful; and it is free from jar,

smell of oil, or steam from the machinery; the fuel used is hard coal, making no smoke.

7. It is so constructed, with an iron water tank partition between the engine and the passenger room as to be perfectly safe and comfortable for passengers.

8. The steam railway car will seat fifty passengers; and will draw one seventy passenger car behind it, over any steam railway grade in the United States, or two seventy passenger cars on all railways of medium grade.

9. The steam railway car will run twenty-five miles per hour, at a cost of not exceeding twelve dollars per 100 miles, for fuel, oil, engineer and conductor; it adapts itself to inequalities of the track with greater ease, is less liable to be thrown off, and causes less wear of rail than other cars. The locomotive, engine and tender being dispensed with, the weight of the passengers gives adhesion of the driving wheels to the rail.

10. For passenger travel on steam roads, for moderate distances, it is peculiarly adapted, and much more economical than the locomotive passenger train as now run, doing the same work at one-half the expense; the dead weight carried per passenger being only from 300 to 400 pounds in the steam car, in place of 1,000 to 2,000 pounds by the usual locomotive train.

By an ingenious combination, this car adapts itself to inequalities of the track with greater ease, is less liable to be thrown off, and causes less wear of rail than other cars. In this car the weight of the passengers gives adhesion of the driving wheels to the rail, thus dispensing with heavy separate locomotive and tender. The economy and general utility of Mr. Woodbury's arrangement seemed to meet the approval of all the engineers present.

Underground Railways.

The selected subject for discussion, "Underground Railways," was then taken up. Gen. Barnum occupied a few minutes in explaining his sidewalk elevated railway in detail. An engineer then replied to Gen. Barnum, and presented some objections to his plan, arising from the expansion and contraction of iron. Messrs. Nasle, Fisher and Dr. Rich joined in the debate; and, without disposing finally of the subject, the association, at a late hour, adjourned.

June 11th, 1868.

Professor S. D. Tillman in the chair; Charles E. Emery, Secretary.

The chairman opened the proceedings by reading the following summary of recent scientific investigations:

The Gold Bearing Rocks.

Sir Roderick Murchison, in the new edition of his "Siluria," has modified the views first put forth by him as to the distribution of gold in the earth's crust. His most recent conclusions are:

1. That looking to the world at large, the auriferous veinstones in the lower silurian rocks contain the greatest quantity of gold.

2. That where certain igneous eruptions penetrated the secondary deposits, the latter have been rendered auriferous for a limited distance only beyond the junction of the two rocks.

3. That the general axiom before insisted upon remains, that all secondary and tertiary deposits (except the auriferous detritus in the latter) not so specially affected never contain gold.

4. That as no unaltered purely aqueous sediment ever contains gold, the argument in favor of the igneous origin of that metal is prodigiously strengthened, or, in other words, that the granites and diorites have been the chief gold producers, and that the auriferous quartz bands in the Palœozoic rocks are also the result of heat and chemical agency.

Phosphorescent Photographs.

The Berlin *Archiv*, for April, gives the following method for making photographs which are invisible in the light, but are luminous in the dark: Sulphate of baryta (heavy spar) is finely pulverized, mixed with gum tragacanth and heated in a closed crucible. Instead of heavy spar, a carbonate of baryta, strontia, or lime, with half its weight of sulphur, may be used. The pulverized product should be kept in a closed bottle. A sheet of albuminized paper is moistened with wet blotting paper; when sticky the powdered substance is distributed equally over it by a tuft of cotton and then dried in the dark. It is printed under a glass *positive*. Only a few seconds are required when baryta is used; with magnesia a little longer time is needed. In the dark, the light portions show the peculiar phosphorescent luminosity, the dark portions being distinguished by a want of phosphorescence. The picture will, however, slowly disappear.

When required to keep, the picture is made on a film of paraffine poured on glass, and covered, while still warm, with the powder, and treated in the same maner as the albumen paper.

Monster Furnaces.

The Rosedale and Ferry Hill Iron Company's establishment at Ferry Hill, England, which, until lately, consisted of seven iron furnaces, each about eighty-two feet high and twenty-two feet in diameter, has been enlarged by the erection of two furnaces, each 105 feet high by twenty-eight feet in diameter. One of these has been put into use, and has proved itself a signal success. The air is supplied by two powerful blast engines, and the material fed by two efficient hydraulic hoists and one balance hoist. When all these furnaces are at work, they will produce annually about 180,000 tons of pig iron.

Durability of Buried Iron Pipes.

A cast iron water pipe, laid by the Old Manhattan Water Company, at the corner of John and William streets, New York, supposed to be more than forty years ago, was recently taken up, and showed no corrosion whatever. It was gray iron, which confirms Mr. McAlpine's opinion as to the value of this variety for pipes. Mr. James B. Francis lately took up some cast iron water pipes at Lowell, Mass., which were laid in 1828. With regard to the condition of the metal, he says: "Thirty-nine year's use appears to have made but little impression upon it."

Venation of the Umbellifers.

An interesting paper was presented at the Royal Microscopical Society, London, by John Gorham, which gives the results of his investigations on the distribution of veins in leaves of that class of flowering plants bearing umbels. He has found that one-half, if not more, of the species belonging to the Umbelliferæ have a kind of venation peculiar to themselves, which consists in the existence of a vein at the very edge of the leaf itself, and which more or less entirely fringes the whole margin. Hence this marginal vein may be said to constitute a form of venation peculiar to this order, and to give a character to it which does not belong to other orders of plants. Mr. J. Hogg, secretary of the society, in commenting on the paper of Mr. Gorham, said, although some other plants have a similar kind of venation, it would be difficult to show that a peculiar kind of vena-

tion runs through the whole of any other order than that of the Umbelliferæ, and that it runs through that order appeared to be a fact. After having carefully examined all the plants he (Mr. Hogg) could get together, they, one and all, confirmed the statement made by Mr. Gorham with regard to this group. It was quite true that some few attempts had been made to classify, or rather tabulate the venation of plants, but only a slight advance had been seen in this respect since the time of Dr. Grew, who, in his treatise on the "Anatomy of Plants," presented to the Royal Society in 1862, noticed the peculiarities of the structure of the fibers of the leaf, and published drawings showing something like an attempt at classification. Now, however, Mr. Gorham proposes to reduce the question of leaf venation to practical utility; and in a large and important order of plants like that of the umbelliferæ, which includes those yielding articles of diet, medicinal substances, and acro-narcotic poisons, it must become a subject of considerable value. A morphological analogy had been shown to exist between the stem and the ribs or veins of the leaf; doubtless an analogy can be traced between the skeleton of the leaf and the skeleton of the branch in a number of points, as well as in the general resemblance between the ramifications of the plant and that of the venation of the leaf. On making a close examination, under a power of fifty diameters, of the leaves of the umbelliferæ, prepared by Mr. Gorham, Mr. Hogg observed that the analogy is borne out in a remarkable degree in the whole, and, further, that the analogy can be carried to the venation of the petals and stamens. The umbels of the hemlock show this exceedingly well, and, no doubt, when others have been more closely examined, it will be found that the plant, the branches, the leaves and flowers, will present a morphology as uniform as it is remarkable.

Marseilles Hair.

This article of commerce, used in the manufacture of chignons, was the subject of a singular revelation made at the Dublin Microscopical Club some months since. Dr. Frazer, on the part of Mr. Woodworth, exhibited specimens of it which had the hair-bulbs unremoved, and the enlargements had been imagined to indicate the presence of "Gregarinæ," but the microscope showed their true nature. An interesting inquiry results as to the origin of this kind of hair in commerce. It cannot be derived from living beings, for its removal in quantity by epilating would be extremely painful; and

if obtained from the dead, it is probably removed when putrefaction has set in.

Mountain Locomotion.

Charles De Bergue proposes to give the locomotive working up steep grades a new climbing power by a novel arrangement, to which, however, serious objection may be made. The engine, tender and cars are all coupled together by a single link, without the intervention of springs or buffers, so that each truck or carriage sustained by four wheels, will be maintained at a fixed distance from the locomotive. The two wheels on each side of the truck or carriage are coupled together in the usual manner and driven by rocking shafts and a continuous pair of connecting rods in direct communication with the engine. On curves it is apparent that while the center line of the train remains unchanged in length, the connection on one side must be elongated, and on the other shortened. Mr. De Bergue believes that with a stroke of two feet this difference will not be more than one forty-fifth of an inch, which may be made up by slacking the bearings. This invention does not successfully meet the difficulty, and the problem of connecting the motor with each segment of a train remains, as yet, unsolved.

Testing the Weight of Coin.

From an article on "Coin and Coining," by Joseph Newton, of the Royal Mint, London, we gather the following interesting information: The automatic weighing machine was introduced at the Royal Mint by Capt. Harness. To Mr. James M. Napier, the celebrated engineer, of York road, Lambeth, however, must be awarded some of the credit of perfecting the mechanical arrangement of the apparatus. The Bank of England had previously adopted an automatic system for the detection and rejection of light sovereigns and half-sovereigns, and this circumstance, no doubt, led to the introduction of a similar plan at the mint. The bank machines took no cognizance of *too heavy* coins; their objection only extended to those which were too light. It will be readily understood that if the mint authorities allowed coins to escape which were *above* the legal maximum weight it would tell seriously upon the expenditure. If, on the contrary, they permitted light pieces to go into the hands of the public, the latter would be defrauded. These exigencies demanded more complexity than was required by the bank automatic machines. The mechanical problem involved in the mint requirements was solved by Mr. Napier, and his machine was found to

perform its delicate and onerous functions with unerring exactitude. At present there are seventeen of these silent but infallible pledges of the accuracy of weight of standard gold and silver coins in the weighing room of the mint. The automatic balances appear almost to be endowed with the faculty of thought. They seem to deliberate, as it were, upon the character of each piece of money submitted to their arbitration, and to acquit or condemn according to the evidence adduced. Each machine is placed upon a low bench or table of cast iron, and at first glance they might be mistaken for so many skeleton clocks covered by glass cases to protect their "works" from dust and humidity. In order to communicate motion to them, a line of small and brightly turned wrought iron shafting, supported by neat pendants from the ceiling above, spans the whole length of the apartment. The shafting is placed immediately over the machines, and fine gut bands passing around pulleys descend to corresponding pulleys on the driving spindles. The lower series of pulleys are immediately outside the machine cases, through holes in which the spindles turn. A small brass weight lever, attached to each machine, serves to tighten the gut band, so as to give motion to the coin-feeding slides, &c., within the cases. Tiny friction crutches, adjustable by the pressure of the thumb and finger, allow of the engagement or disengagement of each machine at a moment's notice. In a remote corner of the weighing room is placed the motive power. This consists of an atmospheric engine, which closely resembles, externally, a high pressure steam engine. It has its cylinder, piston, slide-valve, governor and fly-wheel. Beneath the cylinder, and forming the bed plate upon which it rests, is a vacuum chamber of considerable area. This is exhausted by an air pump, and the extent of rarefaction within the chamber is controlled and regulated by a relief valve and barometer gauge. When this atmospheric motor of the automatic machines is required to be placed in action, a stopcock is turned, and a communication is thus made with the air pump. A stream of air from the room then rushes through a bell-mouthed tube of brass and presses upon the piston of the engine. The rotary motion follows as if steam were the agent employed to effect it. The advantage of this arrangement is that a uniform rate of speed is obtained for the overhead shafting, by the intervention of a strap and pulley, and so for the automatic machines. Without that uniformity accurate weighing would be an impossibility. It has been remarked that "those who think twice before speaking once, speak twice the better

for it;" and it is certainly exact to remark that the weighing balance which is allowed due time for acting will yield far more truthful results than that which is not. One of the great principles necessary to be observed in correct automatic weighing is regularity of motion, and another deliberateness. It has been stated that the law of gravitation is infallible, and it is so; but it must be allowed fair play and freedom in time to insure that infallibility. As the mind of a judge in a court of justice must, if his decisions are to be just, be alike unswayed by passion and by prejudice, so must the mute arbiters of mint coins be free from disturbing causes of any kind, if their conclusions are to be truthful. Having thus, as fully as circumstances will permit, explained the various appliances for giving motion to the automatic weighing machines, let us return to the batches of coins which have been transferred to the judicial department in which they are placed. We will suppose that fifty or sixty *journees* of sovereigns, stamped, milled, and apparently fitted for the business of active life, are about to undergo the final test of their fitness for duty, namely, that of individual weight. They are first weighed in the quantities named, by means of a large hand-balance, of which it is only necessary to say that it is extremely sensitive. The use of this primary weighing in bulk is that it may furnish a check upon the work people who are to feed the automators, and otherwise wait upon them when in action. Having noted minutely the actual weight of the whole importation of coins, they are forthwith distributed among the self-acting machines. Each of the latter is surmounted by a spout, placed at an angle, and supported by a strut. This spout or slide is the receptacle for coins, and in it they are placed in rouleaux, where they rest until the machine is started. Then a small plate of steel, below the base of the spout, advances and recedes at a speed of twenty times either way per minute. In its advancing movement it presses forward a single coin until the latter rests upon a tiny scale-pan, forming part of a fine steel rod, which is delicately poised and so adjusted as to move the beam, or to be moved by it, as it may be too heavy or too light. Above the opposite end of the beam depends another rod, which, terminating in a loop or cage at the base of the machine, sustains a glass counterpoise weight of the legal minimum weight of a sovereign. Below the cage, but not attached to it, is a miniature "stirrup," in which rests a piece of platinum wire (platinum is preferred because it is less liable to oxydation) of the precise weight of the legal

difference or "remedy" allowed as a compensation for imperfection of workmanship. During the three seconds which each piece of coin is permitted to rest upon the scale, its fate or fortune is decided. If its weight exceeds the legal point one iota, it naturally depresses the other end of the beam upon which it has been placed, and as a consequence, the other end is raised, and with it the stirrup and remedy wire. This is fatal. The slide presses forward another candidate,and this latter pushes the condemned coin off its seat, and takes its place. The culprit falls through a flat, brass tube, and is conducted into the "too heavy" recess below the machine, there to await its punishment, a return to the crucible. The lowest office of the conducting tube is made to vibrate over three spaces of slats below, and these lead to the "light," "medium," and "heavy" compartments. At the instant the two heavy coin were dismissed into the tube, the lower mouth of the latter was held by a mechanical finger, itself governed by the movement of the beam, over the innermost or "too heavy" slot. The succeeding coin may, for illustration, be supposed to err on the other side of the standard. In this case the glass counterpoise descends, the defaulter is detected, and summarily ejected into the condemned cell for "light weights." When an intermediate or medium coin is placed on the pan, the beam maintains its equilibrium during the whole of the three momentous seconds, and the coin descends into the "accepted" chamber. In this way these automaton judges try, and acquit or condemn all coins submitted to their judgment. They pursue the "even tenor of their way" from morn till night, and collectively are capable of deciding upon the characters, and awarding the destinies of 200,000 sovereigns per day. This system of automatic weighing is economical in the highest degree; for, although each machine has cost more than $1,000, they have, to use a common expression well understood, *paid* for themselves over and over again. From the careful manner in which all the antecedent operations are performed at the mint, not more than five per cent of the coins weighed in the mint balances are rejected by them. At the close of each day the whole of the coins in the weighing room are again weighed in *journees*, at Oertling's balance; those which are "good" being sent forward for circulation, and the rejected going to the melting pot.

In relation to the item on phosphorescent photographs, Prof. Vanderweyde remarked that after the diamond has been exposed to the sun for some time and then taken into the dark, it will shine. Some diamonds will exhibit brightness for hours, and others only for a few

minutes. When a piece of ice is exposed to the sun on a dry winter's day, it will shine in the dark; the ice must be dry. The luminosity of ice water is entirely due to electric action. The insects which show this light have their luminosity deep in the body; this light is also electric.

Officers of the Association.

Dr. Warren Rowell announced that on Monday evening last the committee of the Institute having the organization of this society in charge held a meeting, and appointed Prof. S. D. Tillman chairman, and Mr. C. E. Emery secretary, of the Polytechnic Association, for the coming year.

Sketch of the Engineers Brunel.

Dr. J. V. C. Smith read a paper on "the Life of a Mechanic," containing an interesting biographical sketch of the elder and the younger Brunel, giving personal reminiscences of an acquaintance with the latter, formed at the great London Exposition.

Machine for Making Horse Shoes.

Mr. O. A. Howe exhibited a small working model of his machine for making horse shoes, which he operated, and distributed many small shoes, made of lead, among the audience. Mr. Howe's horse shoe machine, intended for making a horse shoe grooved centrally on the under side, so as to act much more effectually in preventing the slipping of horses upon pavements than the ordinary calked horse shoe, but which has not been manufactured before the advent of this machine because of the difficulty of displacing metal in the center of the under surface of the shoe in order to form the groove. This machine effectually performs this function, giving the proper grooved shape to the shoe without any waste of material, and is furthermore capable of making the ordinary shoe, either plain or calked, at the rate of twenty shoes per minute, and by a slight change and adjustment of parts may be made to shape shoes of any desired size. The inventor also claims that, by making the shoe grooved and complete for use, no expense is involved in fitting up by a blacksmith, as has always hitherto been required, and the cost of keeping a horse shod in good order is reduced in the neighborhood of one-half as compared with ordinary shoes.

LIFE SAVING APPARATUS.

Mr. L. Mendelsohn exhibited the life-saving apparatus of the "National Life-saving and Ship-ballasting Company," which apparatus is described as consisting of "a cork jacket, which being adjusted and a rubber suit slipped over the wearer's dress, covering the whole body, with the exception of the face and the hands, protects the wearer and such valuables as he may have on his person, and keeps him comfortable and free from cramps. Shoe weights keep him in an erect position in the water, and hand devices enable him to propel himself to shore or other place of safety." An individual present put on the apparatus and presented an appearance quite as unique, but considerably less picturesque, than the mermaids supposed to haunt the shores of "the sunny isles that laugh beside the sea." The apparatus was, however, spoken of with approval by several members present, and there appears to be no reason why it will not perform the object for which it is designed. It is intended to be accompanied by a peculiarly constructed can for holding water and provision sufficient to sustain life for several days, and serving also to sustain a flag or signal of distress. The members were invited to see the apparatus practically tested on the next day, in the East river, near Fulton ferry.

BUCKLES COATED WITH HARD RUBBER.

Mr. Voorheis exhibited a buckle made of iron covered with vulcanite, as a specimen of a new variety of harness trimmings. It is claimed that thus made the trimmings are more durable, easier kept clean, and present a neater appearance than those covered with leather in the usual manner.

NEW COMPOSITION VALVE.

Mr. Sutherland exhibited and explained a valve for steam engines and pipes which is made of mica, rubber, plumbago and other substances. The valve is to be used in the same manner as the ordinary check-valve.

UNDERGROUND RAILWAYS.

The time for taking up the regular subject for discussion having arrived, Mr. Fisher read a paper which, for the most part, appeared to be a repetition of his views, hitherto frequently expressed, with reference to the use of steam carriages on iron pavements, in whatever plan may be adopted for city railway transit.

Mr. Charles E. Emery in a few remarks stated that he did not think that mere openings provided in subterranean ways would prove sufficient to properly ventilate the same, but that special arrangements would be required to effect this purpose.

The object is to determine, approximately, the quantity of heated gases that must be removed from a railway tunnel to keep the air pure. As a starting point, we may suppose that a heavy train is drawn past a given point every five minutes by a locomotive of 400 horse-power. Taking the time when the train is being brought to rest and the stoppages into consideration, we may safely assume that the power required would average 300 horse-power acting continuously. Three hundred horse-power passing every five minutes is equivalent to sixty horse-power passing every minute. Supposing that coke is burned and the steam exhausted into condensing-tanks, we may assume, as a maximum, that it would require seven pounds of fuel per horse-power per hour, equal to seven-sixtieths of a pound per horse-power per minute, or seven pounds for the sixty horse-power passing every minute. Each pound of coke would require theoretically about twelve cubic feet of air, and practically at least twenty feet. Considering the greater density of the resulting carbonic acid gas, the bulk of the escaping gases would not be increased by heat to twenty-five cubic feet per pound of coke. As seven pounds are burned per minute, 175 cubic feet of heated gases would issue from the smoke pipe during that time at a temperature of at least 500 degrees. If the gases mixed with four times their volume of air in the tunnel, at say seventy degrees, we should be obliged, in order to secure ventilation, to withdraw 700 cubic feet of heated air and gases, at a temperature of 156 degrees, every minute. At an average speed of eleven miles per hour the heated air would be distributed over 1,000 feet in the length of the tunnel. Were ventilators placed about one-twentieth of a mile apart, each one should deliver nearly 200 cubic feet of air per minute. Such a quantity of air cannot be displaced by simply putting openings through the surface at intervals, but it may be by constructing two sets of openings, those for cold air at the street level, and high chimneys, built in the adjoining buildings, to carry off the heated air.

It is more than probable that the figures given are too small, by half, to meet the requirements of a tunnel in this city. The object of the calculation is to show that the subject of ventilation in an underground way is not to be trifled with; that it cannot be accom-

plished at all, when steam is used, without especial and expensive contrivances. This question will determine better than anything else *what kind* of a road is best for this city. The underground street, or combination of tunnels, bridges, and open cuttings, is the surest of success, because already in practical operation elsewhere. If land is too valuable to adopt this plan, then a regular system of ventilation must be worked out for covered ways, so that steam may be employed, or, better still, the system of propulsion by compressed air should be established on a proper scale, which will also ventilate and cool the tunnel.

Dr. W. Rowell remarked that ice was very essential in ventilation, especially in a room. He proposed to have a large dish filled with ice about a foot above the floor; this would permit condensed air to come into the room. With ten cents worth of ice a room of twelve feet square could be made quite comfortable for an evening.

Dr. L. Bradley in further elucidation of his views expressed at a previous meeting read the following paper:

The Tunnel Railway.

It will be recollected that, at a previous meeting, the plan which I proposed as feasible for the relief of Broadway, and to facilitate communication through the great city of New York, was derided by certain individuals as being visionary and impracticable, especially when I claimed that, with ample means and men, provided beforehand, the work could be accomplished in six month's time.

It seems, therefore, proper I should now give a few estimates and figures, such as I have been able to obtain from unquestionable authority, to show not only the practicability, but the entire feasibility of the plan.

I proposed to construct a tunnel, not under any particular street, but upon a straight line from South Ferry to Harlem bridge, which will pass directly under corner of Broad and Pearl streets, eastern part of the park, diagonally under Elm and Crosby streets, under the angle of Broadway at 10th street; thence diagonally across 4th avenue and parallel with 4th avenue, midway between that and Lexington avenue, and following the same line to the bridge.

I proposed to put it at a level, beneath all cellars, sewers, mains, etc. To be thirty feet wide and to average twelve feet from the top to the bottom.

I proposed at the way stations, at every 832 feet, to sink a shaft on

either side for the passage of elevators where stationary engines are to be employed for moving the elevators up and down, and for other purposes. Half way between the stations a single shaft is to be sunk. Let the work of excavation commence simultaneously at all the shafts, and when the bottom shall be reached, let parties of as many men as can work to advantage go on drifting in line of the tunnel in both directions from each of the shafts. This will give, for each party, a section of 208 feet, or sixty-nine and one-third yards; each lineal yard gives forty cubic yards, making 2,773 cubic yards' excavation per section.

From Cressy's Encyclopedia of Civil Engineering, London, 1847, I quote estimates which have been derived from much experience of the labor of excavation. By this, a man will excavate, ready for removal, per day, 22.2 yards vegetable earth; 14.92 yards loam; 9 yards clay; 6.67 yards stony earth; 5.4 yards turfa; 2.7 yards solid rock. Now, let us take a section of solid rock, of which we shall encounter considerable, and which will require more time than any other excavation. 2,773 cubic yards, at two and seven-tenths yards per day, will require 1,027 days. If the party consists of twelve men, which is by no means large, they will do the work in eighty-seven days, or less than three months. Assuming wages at three dollars per day, the cost per section will be $3,081, and a mile of twenty-five sections, will cost $77,025 for excavating and preparing the material for removal. It is said, and I think truly, that the material will remove itself, *i. e.*, it will command a price that will pay for its removal. To facilitate the latter process and the advancement of the work, the party of diggers will be followed up by other parties, whose duty it will be to lay down the ways (of which there will be four tracks—two for way, and two for through passengers), over which, by means of trucks, the material will be run to the elevators, which, in turn, will raise it to the surface; also to perform the mason work, where masonry is required, and to finish up the work generally. Thus, in four or five months, a single section will be completed, and if each section is completed in five months, the whole work will be done in the same time. It appears, then, as I first stated, that, with ample means, and men provided beforehand, the work can be accomplished in six months' time. I do not say that it would be politic or profitable to rush so great a work through in so short a time; I only say that it is practicable. It might be better to occupy a whole year or more; but to procrastinate beyond

two years, would, in my estimation, be folly. The cost of the right of eminent domain and the purchase of necessary lands, it is impossible to estimate till after the survey and contracts are made; but I think it entirely safe to say that the cost of all recited rights, running stock and complete equipments, will not exceed nine times that of the excavation. If so, it will bring the work at less than $775,000 per mile.

At each intermediate single shaft, after the removal of the excavated material is completed, I propose to erect a stack or chimney to a proper height with appliance at the top to secure a constant draft from the tunnel. This, with the constant ingress of fresh air at the stations, and the movements back and forth of the cars, will secure a good, wholesome ventilation, even if we use dummy, or smoke-consuming engines. But, instead of steam engines of any kind in the tunnel, I propose to use pressed air engines. The steam engines at the several stations besides working the elevators, may be employed in compressing air, by means of some of the lately improved air presses, one of which was shown us here at a late meeting. The pressed air receiver, or magazine for each car, may consist of eight or ten iron tubes, say six or eight inches diameter, extending beneath the car, its whole length, so connected as to make them a common reservoir. This, with a pressure of say twenty to thirty atmospheres, will contain force enough to propel the car rapidly two miles or more. Furthermore, when the valve is closed for stopping the car, the force which has been converted into momentum in the car, and its contents is now exerted upon the engine by a reverse action, in pumping and refilling the reservoir, and the resistance of such action helps to serve the purpose of a break in stopping the car.

In this arrangement there is remarkable economy in the conservation of force.

The magazines at the several stations should be composed of a large number of pipes or small cylinders, capable of sustaining great pressure, and connected by a common pipe running through the tunnel from end to end, which will convert them all into one great and general reservoir, to be provided with suitable check-valves, so that in case of sudden and rapid exhaustion on account of accident of any kind, the accumulated pressure may be saved from general and entire loss.

The magazine of any car may be replenished to full force from the general reservoir at any station in ten or fifteen seconds, and with great facility.

The transit of passengers, &c., between the surface and the cars will be performed by the elevators, which will regularly ply up and down, one ascending while the other is descending, offering a much more agreeable mode than that of climbing up and down stairs, and in every way as satisfactory and as pleasurable as that by the elevator exhibited at the late fair of the American Institute, on which so many thousands of men, women and children were seen daily to ascend and descend for mere pleasure. This was one of the great attractions of the fair, and those *tunnel* elevators will be equally attractive. The movement of the cars and the continual discharge of so much pure air in the tunnel will insure ample circulation and the most perfect ventilation.

The roof of the tunnel in all parts where masonry is required will be that of a double archway, the middle to be supported by a line of iron columns. In solid rock there will be but one arch.

Ornamental chandeliers will brilliantly illuminate the whole tunnel, and its temperature will be at all times as we desire, "warm in winter and cool in summer." Men, women and children will at every convenience come here to enjoy a ride, which shall be in no way inferior to that of a delightful carriage ride, in clear, airy, and pleasant moonlight, on which the poets so much delight to dwell.

This plan has been objected to by sundry individuals. Mr. Gardner says it is impracticable on account of the quicksands to be encountered at that depth, and also the impossibility of proper ventilation.

He who speak of quicksands as a serious difficulty in engineering now, is wofully behind the times, and is ignorant of the fact that modern chemistry has furnished us with the ready means of depriving quicksand of its peculiar mobility, and of converting it into a substantial earth, easily spaded, or, if you please, into solid rock. What did he expect to do about the quicksands that might be encountered in the Broadway arcade; did he suppose it impossible that there could be any there?

General Barnard has many objections to all kinds of tunnel ways. But the asperity of his objections is much relieved by the kindly manner in which he speaks of the proneness of men to differ in their views and opinions. He says that in practical matters, as well as in religion and politics, one person will think in one direction and another in a direction directly opposite, and with the milk of human kindness and christian charity, he admits that they are both equally honest.

I must therefore, and I most cordially do, accord to him the most perfect *honesty* in all he says, not only in advocacy of his own elevated way, but in objection to my tunnel way.

While he confines himself to the advocacy of his own way, I can walk with him in comparative harmony, for I should feel myself unjust if I did not admit that his method is plausible, his arguments are cogent, and his points are generally well made.

There is, perhaps I may say, but one fear which I have in regard to his elevated railway. It is a fear which I entertain in common with many others, with whom I have conversed, viz.: The danger, or rather the want of entire safety in a way so high. If the general can argue me out of this fear, I shall be "almost persuaded," and perhaps quite persuaded not only to be a christian in point of charity, but an advocate of his elevated way.

But in what he says of underground ways, we do not so honestly agree, but we honestly differ. In the pamphlet he gave us, of which his expose was a pretty faithful reiteration, he says: "The London tunnels, including right of way, stations, and equipments, cost about \$5,500,000 per mile. Can one," he asks, "be put through Manhattan island any cheaper?" "Not if it be done under the supervision of a metropolitan commission. At that rate a tunnel from the Battery to Harlem would cost over \$45,000,000." "We have faith," he says, "in the power and skill of engineering. It can be done. It is within the limit of possibilities." But *will* it be done?

In another plan he says: "We assert, that no double track railway tunnel can be constructed and operated from Bowling Green to Harlem in less than ten years." A wide difference this in our *honestly* entertained opinions; his, a double track way in ten years, and mine, a quadruple track way in half a year, or at farthest, in two years. But how happy are we in knowing that we are all *honest* in all these differences.

And now, to be serious, I am disposed to admit that two or three miles of track, of the elevated railway, may be constructed in the time and at the cost of every one mile on my plan. And I honestly believe that three or four miles upon my plan can be constructed in the time and at the cost of one mile of the arcade way, advocated by Mr. Gardner.

I have listened with much satisfaction for several evenings past to the discussions upon this important subject. They have been in the main harmonious and instructive, though at times seasoned with

some little personalities; but nothing of serious consequence has occurred.

Now, I propose that we compromise and settle all differences upon the following terms. The several plans proposed are all practicable, and may all be made profitable to proprietors and useful to the public:

Therefore, let us adopt them all, and lay the whole open to enterprise and capital. If the proprietors on Broadway want the arcade let Mr. Gardener make it. Let Mr. Fisher start as many steam carriages on iron floor roads as he pleases. Let General Barnum erect elevated ways with pneumatic tubes all over the city; we want them all; they will pay. As for myself, I have no axes to grind. I shall not engage either in person or capital in any of these contemplated enterprises. My plan and all my suggestions are free, any one can appropriate them in welcome. Should any one think favorably of my magnificent plan of compressed air propulsion, I will take pleasure in communicating some further information in relation to it.

It is a method that may be employed on city railways, either underground or elevated, to better advantage and with more safety than that of running steam engines on the track. Compressed air is just as powerful in its expansive force as pent up steam; is just as easily regulated and controlled; is more cleanly and pleasant, and is much more safe.

But, whatever you may do in these great enterprises, be careful to eschew monopoly, let all be open to free and wholesome competitions, allow no exclusive privileges or watered stocks. And finally, let each company, after dividing six or seven per cent on actual cash investment, contribute a large per centum of profits to the city, for the benefit of the poor and for educational purposes.

At the conclusion of Dr. Bradley's remarks, the discussion was continued to the time of adjournment. In accordance with a resolution passed at a previous stage of the proceedings, providing for a summer vacation, the association then adjourned to the second Thursday in September next.

September 10, 1868.

Samuel D. Tillman, LL. D., Chairman; Mr. Charles E. Emery, Secretary.

The chairman opened the proceedings with the following address:

Gentlemen of the Polytechnic Association — I heartily greet you at our autumnal opening, confident that you are now ready to resume your scientific investigations with renewed vigor. It has been our custom to report, at each meeting, on the progress of invention and discovery, and more particularly on those novelties first published in Europe. As opportunity occurs I shall present the scientific notes which I have compiled since our last meeting. In our own country the most interesting event of the past summer was the meeting of the American Association for the Advancement of Science, at Chicago, extending from the 5th to the 12th of August. The attendance exceeded that of any preceding meeting; the number of members reported as present, including those there admitted, being about 500. Nearly all the leading universities and colleges were represented by presidents or professors, and the American Institute furnished its full share, five members of the Polytechnic Association being present. Over 150 papers were presented and nearly all of them were read. During the latter part of the session it was found necessary to subdivide sections, so that four meetings, for the reading of papers were held at the same time. An abstract from the most important of these papers will be laid before you after the official report of the secretary has been received. The seventeenth annual meeting of the association was characterized by the harmony of its proceedings, the great variety of topics presented, and the ability evinced in its discussions. Its complete success was in a great measure due to facilities afforded by the citizens of Chicago and the generous manner in which every wish of its members was met. Nothing more was needed to confirm the general opinion as to the benefits arising from these annual gatherings. They accomplish for science, what conventions do for religious, political, and commercial objects, by securing unity of purpose, concentrated effort, and expeditious action. Indeed, they do much more in dispelling illusions, which are often palmed off as truth, among those who are only captivated by novelty. While discovery is constantly extending her domain, opening new paths of progress and erecting new beacons, to direct those who are to follow, it is the special duty of advanced men to see that no false lights are shown,

which would lead to the propagation of unsound doctrine. Every new hypothesis or induction should be subjected to the keenest scrutiny of those who are competent to pass upon its merits. A scientist, who reads a paper before his peers, reaches at once the appreciative audience he most desires. If he describes new experiments, they, more than all others, are interested in the results; if he advances new views they are ever ready to question the correctness of his conclusions. Thus, it frequently happens, that the discussion immediately following the reading of a paper, will dispose of objections, and establish positions which could not be reached in a long time through the medium of printed dissertations. Moreover, the suggestions often thrown out during the free exchange of ideas in a verbal debate, are of great service in exciting that enthusiasm in the votary of science which prompts him to higher efforts in the pursuit of truth.

The beneficial influence of these scientific associations is not so obvious here as in Europe, where they are older and more firmly established. Of late the British Association for the Advancement of Science has accomplished much; yet it will be remembered that, even after its formation, Sir John F. W. Herschel, in a note appended to his able treatise "On Sound," in the Encyclopædia Metropolitana, acknowledged his indebtedness to foreign journals for a portion of the information he then presented, and expressed his regret that so little attention was paid in his own country to what was being done by scientific men abroad. "Here," said he, "whole branches of continental discovery are unstudied, and indeed almost unknown, even by name. It is in vain to conceal the melancholy truth. We are fast dropping behind. In mathematics, we have long since drawn the rein, and given over a hopeless race. In chemistry, the case is not much better." These and other words of regret and reproof then written, doubtless hastened the great and favorable change which has since taken place in his country. Certain it is, that the formation of the British association has led to the happiest results; for to-day it may boast of many distinguished names in almost every branch of science.

If there is any hindrance at present to the progress of truth, both here and abroad, it arises chiefly from the spirit of exclusiveness sometimes evinced by those who have devoted their lives to the study of physical laws. This should not excite surprise, because the tendency of abstract science is essentially aristocratic. The man who

knows, stands on a higher plane than a man who does not know. Hence, the position of the scientist is impregnable; he has riches and power, of which he cannot be robbed; should he find his chief enjoyment, however, in the reputation he has acquired, he may well fear rivalry. On the other hand, if he pursues truth for the love of it, he will welcome all who labor in the same spirit, and extend to those below him a helping hand.

The study of natural laws in the abstract, undoubtedly affords pure enjoyment; yet this feeling is vastly intensified by witnessing their successful application for the accomplishment of new and important results in the useful arts. Such results are often brought about by the artisan, who, although he may know but few of these laws, understands most thoroughly all the conditions, peculiar to his art, under which they can be effectually applied. Our great inventors have not, generally, had the advantage of a liberal education. By ingenuity alone they take the lead, and of course counteract, to a certain extent, the haughtiness sometimes engendered by learning.

Scientific associations will be entirely successful when they fully recognize the fact that science, in these modern times, has a double mission. From serene heights she beckons on the student who longs for clearer views of the divine plan of the universe; yet often she descends to the humblest abodes of man, and watches while invention weaves some new device. Thus, we find her potent influence in those improvements which lessen manual labor, supply corporal wants, and add to the material resources of our race. We, of the Polytechnic, welcome her in both offices, as revealer of long hidden links in the endless chain of sequences, and as prompter to new combinations of some of these links, by which the surplus powers of nature are successfully applied to ingenious mechanism, and by which even new forces are generated, and made obedient to the will of man.

MINERALS FROM COLORADO.

Dr. L. Feuchtwanger exhibited some minerals from Colorado, containing 603 ounces of silver, and 230 pounds of lead to the ton. The cost of transporting a ton from Colorado to this city is $150.

NEW DIRECTORY AND LETTER BOX.

Mr. Coffee showed a directory and letter box for large buildings, the object of which is to facilitate the delivery of letters to the occupants, and also serve as a directory. The apparatus consists of a num-

ber of boxes with the number of every room and the name of each occupant placed on the outside, each box having a lock and key. The apparatus being placed at the entrance to the building, the letter carrier can at once see the box in which to place the letter.

New Traveler's Trunk.

Mr. Hudson exhibited a trunk, the covering of which was made of slats of hard wood, riveted transeversely to the pine wood of the box. This plan increases the strength of the trunk very much. The usual covering of leather hardly giving any strength at all. The trunk was a well finished specimen of the kind. It weighed about the same, and the cost is equal to the leather trunk. One of this kind would be thirty-five dollars.

Dr. J. B. Rich remarked that canvas saturated with linseed oil was a much better covering for trunks than leather, that is, if the duck or canvas is thoroughly saturated. It is far superior to sole leather, as it will not stain with grease. In regard to the strength of trunks, he had lately witnessed some experiments with them. He saw a trunk having India rubber placed on the corners, which was filled with books, and thrown down a distance of twenty feet, and yet it did not sustain any damage. These trunks are manufactured by J. C. Gilmore.

Mr. Newberry thought that saturating the canvas with oil would decompose the canvas.

Steel Plated Cast Iron Axes.

Dr. W. Rowell exhibited some cast iron axes, plated with steel. The steel facing is struck up with a die, and the cast iron, in a molten state poured on it; a perfect union of the steel and iron is thus effected. The price of the axes is about half that of cast steel. Mr. Meigs, of East Berlin, Conn., is the inventor. The steel being laid in the sand and the cast iron poured on it, there is no waste of the steel, and a thorough weld of the steel produced.

Steel Bridle Bits.

Dr. Rowell also showed some cast steel bits, made by Mr. B. T. Henry, of New Haven, Conn. The rings of the bits are made of steel wire and the ends are melted together with the flame going through perforated brick, and when at a welding heat the ends are squeezed together, which makes a perfect weld, requiring no after finishing.

NEW OIL GAS LIGHT.

Dr. D. D. Parmlee exhibited Mr. Theodore Clough's oil gas light, and read the following paper on that subject:

It is deemed necessary, before describing Mr. Clough's invention, to explain, in a short and general manner, the nature of petroleum burning oil, which he employs; and, also, the other products derived from crude petroleum, in their relation to artificial illumination; for the reason that it is common to discover the want of a proper understanding of this subject by those, who, in most other respects, are of acknowledged talents.

Crude petroleum varies in different localities in several physical and chemical respects. In some instances it is a heavy paraffine oil, holding paraffine in solution to an extent which adapts it to purposes of lubrication. In other localities, more limpid oil is found, consisting of a gradation of hydrocarbons varying from about thirty-nine degrees to ninety-five degrees Baume. For commercial purposes these products are separated by distillation into, first, "gasoline" of specific gravity seventy degrees to ninety degrees Baume; secondly, "naphtha" of fifty-nine degrees to seventy degrees; thirdly, oil for burning, which will answer the tests adopted by the United States government, and which is known as the *fire test.*

The apparatus usually employed for testing oil is made of metal and glass, consisting of a cup holding about a gill, resting in a water bath which is situated immediately over a spirit lamp. The oil to be tested is put into the cup and the bulb of a standard thermometer is immersed in it. The lamp is next lighted, and the water bath gradually heated. At every degree of the elevation of the temperature of the oil as indicated by the thermometer, a lighted taper is rapidly passed over and near the surface of the oil in order to learn precisely at what degree any light products which may be contained in it are volatilized. This is known by a momentary flame and flash of light over the surface of the oil. The elevation of temperature is continued, and the trials repeated until a continuous flame is formed. The temperature at which this occurs is the commercial fire test. The law requires that this burning shall not take place at a temperature less than 110 degrees Fahr. Oil which will stand this test has been decided to be safe for general use for illumination, transportation and storage, under the exercise of those precautions required in handling all combustible liquids.

The test above described when applied to naphtha at ordinary

temperatures of the atmosphere ignites it, and a continuous flame results. Gasoline is even more sensitive than naphtha, as it ignites at temperatures of the coldest days of our winters.

The value of these tests will be readily understood when it is remembered that all hydrocarbons in the gaseous form mixed with atmospheric air, in the proportion of seven to twenty per cent, constitute an explosive mixture; and that the fire test properly performed discovers the presence of light products in the oil by indicating the temperature at which inflammable products in gas form are expelled. And more importance will be attached to it when it is considered that twenty per cent of the products resulting from the distillation of petroleum are the light products, which mix with air, at a temperature produced from solar or artificial heat, under nearly all the circumstances attending the transportation, storage and use of oil. These light products, in consequence of their volatility and hence danger in the respects mentioned, command a price of only about one-third that of oil which will stand the fire test adopted by the government.

There is, therefore, an inducement for a questionable class of dealers, if we may use the mildest expression, to remix these cheaper products after they have been separated by the refiner and passed the hands of the inspector. It is believed that this is too generally practiced by retailers; and hence the quite frequent occurrence of accidents, as mis-stated and supposed, from petroleum burning oil. In every such case, if a proper investigation is instituted, it will be found that ignorance, carelessness or fraud has been the cause.

Ignorance, from the want of a knowledge of the proper qualities of a safe oil; carelesseness, in not exercising that knowledge when possessed; or fraud on the part of the dealer, who may have secured the confidence of his customer and thereby been able to impose upon him; taking the risk of the occurrence of an accident for a small addition to his profits.

For burning petroleum oil there are a great many lamps of various design, complication and value, all of which, however, partake, more or less, of the character of *Argand's, the Annular French lamp, Parker's or Quarrel's Sinubra, the Isis, Carcel, the Solar, Young's Vesta, Rumford's* and the *Fountain lamps of Keir and Parker*, which have been in use for burning fat oils during the last fifty to eighty years. Much ingenuity has been exercised in adapting these lamps to the use of petroleum, and with such success that some

of them are perfectly safe with proper oil, and could not well be dispensed with by the public.

The inconvenience of glass chimneys, their liability to become smoked and broken, have incited many plans during the past twenty years, to produce a gas flame from liquid hydrocarbons, nearly all of which have been based on the use of light, volatile products derived from coal tar, coal oil and petroleum distillation, and which are known as naphtha, benzole, benzine, gasoline, &c., &c.

Charles Blachford Mansfield was the pioneer of this class, as will be seen by reference to his patent, granted by Great Britain in 1847, and numbered 11,960, in which he claims the "passing of a current of gas or air into a vessel in which it shall become charged with the vapor of a spirituous substance, such as may confer on it the property of burning with a luminous flame, at a burner which may be distant from the reservoir."

Since the date of the above patent, many changes have been contrived by several parties for the purpose of remedying the difficulties found in the practical working of Mr. Mansfield's plans. But at the present time, no improvement is known which renders the use of any of this class of light hydrocarbons unobjectionable, and it is probable there never will be, for the reason that however volatile the liquid may be which is employed to saturate the air, recondensation will take place when it is carried any considerable distance through cool pipes, stopping the pipes, producing irregularity of the flame first, and finally stopping the pipes entirely.

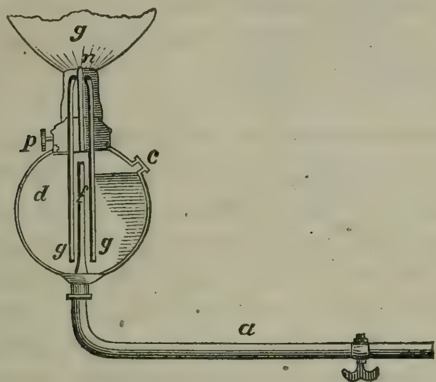
Another and important objection to these plans is the danger of transportation, handling, storage, and use of these highly volatile products, the low cost of which has led to the concoction of various recipes for making them safe or non-explosive, which have been quite extensively sold by parties who are either unpardonably ignorant, or dishonest; and severe penalties should be imposed upon every person engaged in such misrepresentations.

The invention of Mr. Theodore Clough, of Dobbs' Ferry, New York, for producing an oil gas flame from petroleum burning oil, which will stand the fire test of the government, as previously described, and which will not ignite until a temperature of fifty degrees Fahrenheit above that test (110 degrees x 50 degrees) or 160 degrees fire test, is novel and simple in structure, furnishing a gas flame equal to that from the best coal gas, at one-third the cost, with-

out passing any hydrocarbons through the pipes to which the burners are attached, air alone being all that is required.

This invention has been recently secured to Mr. Clough by three patents.

The following is a general description of the burner:



a represents the pipe to which the burner is attached; *d* the receptacle for holding the oil; *c* the valve through which the oil is poured; *f* air-pipe; *gg* tubes, containing each a wick; *p* screw for regulating the wicks; *n* is an ordinary bat-wing gas-burner; *g* represents the flame.

Common air is forced through the pipe by means of any of the gasometers now in common use, at a pressure for a full light of about one and a half inches.

The volume of air required to support the flame is about four cubic feet for a flame equaling that of a five feet gas burner, with good coal gas. The greatest diameter of the oil-receptacle is four and a half inches, and its height four inches; holding, when fully charged, about a pint and a half of oil, which will furnish a full flame twelve hours, at a cost of seven and a half cents, the present cost of oil being forty cents per gallon.

The flame may be regulated with the same facility as that of coal gas, forming a small light, or a large spread of flame, as convenience may require.

Where pipes are in dwellings or factories, the only expense for introducing Mr. Clough's invention, is simply that of the burners.

In factories where difficulty has been experienced in manufacturing a regular supply of gas, the burner has simply to be attached to the pipes, air pumped into the gasometer, and no disappointment will occur from a failure to obtain a fine gas-light.

The chairman presented the following notes on science:

THE APPROACH OF SIRIUS.

Mr. Huggins has made a subtle application of spectroscopic analysis, by which he determines whether a celestial body is approaching or receding in consequence of a change in the refrangibilities of light produced by a modification of the ethereal waves. He announces as one of the remarkable results of his investigations that the bright fixed star Sirius is approaching the solar system at the rate of twenty-nine and a half miles per second.

PERTURBATIONS OF OUR PLANET.

That class of perturbations known as "secular," have been profoundly investigated by John L. Stockwell, who, in the July number of *The American Journal of Science and Arts*, under the title of "The Secular Variations of the Elements of the Earth's Orbit," has given the results of his computations showing the eccentricity of the earth's orbit during a million of years; and this is but a continuation of calculations, previously published by him, extending over the preceding million of years; so that his tables and charts now include more than 2,000,000 of years. The materials used in the preparation of the formulas on which the tables are based are the same as those used in the construction of the *American Ephemeris and Nautical Almanac* with the exception of the mass of the earth which has been increased 1-351132. Mr. Stockwell has determined anew the secular variations of the elements of the orbits of the eight principal planets, and the constants obtained differ somewhat from those obtained by Le Verrier, who made his investigation before the discovery of neptune and the correction of values relating to the masses and elements of other planets. From Le Verrier's formula croll, some years ago, made and published a similar computation to that of Stockwell's, but it was much smaller, and was based on much longer intervals, namely, 50,000 years. By using intervals of 10,000 years, Stockwell is enabled to show many maxima and minima, which it is evident would escape notice if the chart was curved by every fifth ordinate. The new chart indicates a curious relation, not so easily discovered by examining the figures of the table; and that is, that the points of maxima and minima are approximately repeated at intervals of 1,450,000 years. In conclusion, the author expresses a hope, which we are happy to change to a positive assertion; we are confident his results will be found of great service in the discussion of those problems of terrestrial physics in which solar

influence (whether heat, light or gravitation), acts as a controlling agent.

The Chicago River Tunnel.

This river subway is intended to prevent the interruption of land travel which is now caused by the passage of vessels. The whole shipping of Chicago is harbored in a narrow river, and a single vessel passing from the upper to the lower end of the harbor requires the opening of the draws in fifteen different bridges. Nearly all vessels must pass through the first or lower bridge, consequently the interruption is greatest in the most busy part of the city. Acting on the suggestion of E. S. Cheeseborough, the city authorities decided to construct a crossing under the river, which was commenced in 1866, and is now rapidly pushed forward. It will connect East and West Washington street, and extend a distance of 1,605 feet, only 200 feet of which is directly under the river. The western approach is 773 feet long, with a descent of one foot in eighteen and a half feet; the eastern is 622 feet, with a grade of one in twelve. The river portion of the tunnel is divided into two arches, and under each is a carriage way, eleven feet wide. The intermediate wall is two feet thick, and contains eleven openings. The side walls are five feet thick, consisting of one foot of concrete backing, two feet eight inches of stone, and one foot four inches of brick lining. All arches are built with inverts one foot eight inches thick, bedded upon two feet of concrete. The top of the structure is fourteen feet four inches below the mean lake level, and three feet below the restored bed of the river. An intermediate wall separates the sidewalks from the roadway, and in recesses at short distances, lamps will be placed to light both. In the approaches to the tunnel proper the two arches are merged into one, nineteen feet six inches wide, by fifteen feet nine inches high, the sidewalk being in a separate tunnel. For the purpose of drainage at the lowest point of the tunnel, in the center of the river, a sump is formed communicating with another sump outside of the tunnel, and just within the river quay, from which the drainage is pumped into a high level sewer. Should this tunnel prove a success, similar structures will be made to connect all the main streets leading to the river.

Chemical Changes.

M. A. Vernon Harcourt, of London, closes a paper "On the rate at which chemical actions take place," with the following propositions

which embody the principal conclusions to which an examination of the cited cases of gradual chemical change has led: 1. The rate at which a chemical change proceeds is constant under constant conditions, and is independent of the time that has elapsed since the change commenced. 2. When any substance is undergoing a chemical change, of which no condition varies, excepting the diminution of the changing substance, the amount of change occurring at any moment is directly proportional to the quantity of the substance. 3. When two or more substances act one upon another, the amount of action at any moment is directly proportioned to the quantity of each of the substances. 4. When the rate of any chemical change is affected by the presence of a substance, which itself takes no part in the change, the acceleration or retardation produced is directly proportional to the quantity of the substance. 5. The relation between the rate of a chemical change occurring in a solution, and the temperature of the solution is such that for every additional degree the number expressing the rate is to be multiplied by a constant quantity.

Crystallization of Sulphur.

M. Schutzenberger has proved, by experiment, that pure melted sulphur may be crystallized, a little below 212 degrees Fahr., in octahedra of the fourth system, without the aid of any solvent.

New Device for Manufacturing Sulphuric Acid.

The apparatus, invented by Mr. Lardani, consists of a furnace for burning sulphur and forming sulphurous acid, a washer or scrubber, a refrigerator, a reacting vessel, and a regenerator for nitric acid. The warm sulphurous acid gas, made by burning sulphur and forced out of the furnace by a current of air, which furnishes oxygen, enters the scrubber and is freed from volatilized sulphur, and especially arsenious acid when arsenical pyrites is used, as the source of sulphur. After passing through the refrigerator it enters the reacting vessel, composed of two parts, the lower containing nitric acid, and the upper pumice stone, resting on plates of lead or aluminum, pierced with holes. The gas passes through the nitric acid, and after receiving another equivalent of oxygen it sinks, in the form of sulphuric acid, to the bottom, while the hyponitric escapes through the pumice stone, and, traversing the upper part of the apparatus, enters the regenerator, where, meeting with an excess of nitrogen, it is transformed into nitric acid, and ready to be used again in oxidizing sulphurous acid.

The comparative economy of this process we are unable to give, but any plan for cheapening the production of the most important mineral acid will excite great interest among manufacturing chemists.

Test for Naphthaline.

Vohl states that when naphthaline is treated with concentrated nitric acid, and the mixture is diluted with water, a precipitate is produced, which after being washed first with water and then with diluted alcohol (three-fourths water), may be placed in a watch-glass with a few drops of a solution of hydrate of potassium and of sulphide of potassium and evaporated to dryness on a water bath. On moistening the residue with alcohol, a magnificent red violet color is immediately developed.

Measuring Telescope.

The ordnance select committee of the war department of Great Britain have approved of the telescope patented by Messrs. Elliot Brothers, London, which enables the distance of either infantry or cavalry to be computed instantaneously. The distance is obtained by means of two wires moved by a disc, on which are divisions showing the remoteness of the object, which is in ratio to the proximity of the two wires between which it is seen. The motion of the wires is produced by a double eccentric moving round the smaller tube of the telescope.

Cerium.

The late Dr. Charles Wolf, of Cincinnati, Ohio, while in the laboratory of Bunsen in Heidelburg, Germany, made an elaborate investigation on the equivalent of cerium. The papers containing an account of his experiments and calculations have been translated for *The American Journal of Science and Arts* by Mr. F. A. Genth, of Philadelphia. The result of the investigation is the number 45.664 (estimating oxygen at eight) as the equivalent of the purest cerium.

Observation of Nebula.

Father Secchi, of Rome, in a communication to the Royal Astronomical Society, London, "On the great nebula of Orion," states that the nebula is seen much better in moonlight than on dark nights. This surprising effect he accounted for upon the optical principle, that the difference of two lights is more easily appreciated when they are weak than when they are strong.

CELESTIAL OBSERVATIONS IN THE SOUTHERN HEMISPHERE.

The expedition sent out from England under Lieutenant John Herschel to observe, in Asia, the great eclipse on the 17th of August next, have already done useful work. ' With a spectroscope furnished by the Royal Society, six nebula have been examined. The great nebula in Arago presents a spectrum of bright lines, like those exhibited by the great nebula of Orion, and is thus proved to be in the gaseous state.

TRANSFORMATION OF ORGANIC BODIES INTO HYDRO-CARBONS.

Prof. Berthelot, of the College of France, has described a simple process by which hydrogen may be substituted for all other elements found in combination with carbon in organic bodies. The reagent used by him is an aqueous solution of hydriodic acid of density two. The quantity of acid employed, always in excess, is greater in proportion as the organic substance to be decomposed is deficient in hydrogen. Both are heated in a sealed tube to 527 degrees Fahrenheit for ten hours. A series of changes take place, which result in transferring the hydrogen in the acid to the carbon and forming compounds generally homologous with marsh gas, or hydride of ethyl. Alcohols, ethers, aldehydes, acids, aromatic carburets, alkaloids, complex nitrogenized bodies, when heated, are broken up by the superior saturating power of hydrogen, which, under these conditions, displaces the strongest electro-negative elements.

BRORSEN'S COMET.

This comet, discovered in 1846, was missed at the perhelion passage in 1851. It was seen in 1857; again missed in 1862, and rediscovered in April, 1868. It must not be confounded with another bearing the same name and revolving in a more extended orbit. The comet just discovered has been subjected to spectroscopic analysis by Mr. Huggins, of London. The spectrum consists of three bright bands, resembling those seen in the spectrum of Donati's comet. Their length proves that they are not due to the nucleus of the comet alone, but are partly the result of the light of the coma. It appears that the nucleus, and nearly the whole of the coma of this comet are self-luminous.

NEW PROCESS FOR MAKING STEEL.

An invention explained at a recent conversazione of the Institution of Civil Engineers, London, consists in grinding pig iron

to powder, by a very rapidly revolving cutter. The great heat generated sets the particles of metal on fire, and after scintillating, they fall down in a reddish brown dust, which is gathered, placed in a crucible, and melted. When cooled this melted dust is found to be ingots of very good steel. It is claimed that the carbon is all burned out, which is, probably, true; but the act of burning has produced an oxyd of iron, in other words, reduced the iron again to ore. If the process is modified so as to produce good steel, still it must be far more expensive than that of Bessemer, or the ordinary mode of making steel from wrought iron.

The Microscope.

A correspondent of *The American Naturalist* thus explains the terms by which the power of the microscope is designated: "English and American opticians name their objectives (i. e., the lens or lenses placed next to the object, that next to the eye being the eye-piece) from their magnifying power; thus a one-fourth inch objective has the same power as a simple lens of one-quarter inch focus. Continental European makers generally distinguish their instruments by numbers, the highest number indicating the highest power; but as each maker has his own system, the actual power of the instrument must be ascertained by trial. Instruments also differ from their names, and they cannot generally be depended on. The theoretical power of the microscope is measured from an arbitrary standard of ten inches; thus, one inch is said to magnify ten diameters, a quarter inch forty diameters. If the standard is taken at five inches, as it is by some, then the 'power' is one-half as much. The power of the microscope is that of the objective multiplied by that of the eye-piece; if the objective magnifies ten diameters, and the eye-piece ten, the result is 100 diameters. Angular aperture is the angle in the surface of the front lens, at which light will enter the objective; the greater the angular aperture, the more light, and usually the greater the resolving power. An amplifier is an achromatic combination inserted in the compound body of the instrument to increase the power of the objective and eye-piece. Immersion lenses have lately attracted great attention, though they were made by Amici many years since. The objective is immersed in water; that is, there is a film of water between the front of the objective and the object, on the thin glass covering it. The effect is a great increase of light and better definition."

TESTING THE POWER OF MICROSCOPES WITH NOBERT'S TEST PLATE.

The lines ruled on glass to a known scale by F. A. Nobert of Barth, Prussia, for the purpose of testing the resolving power of the microscope, are of such exceeding fineness in the most minute divisions of space, that the maker has asserted it was impossible that they could ever be seen, and until recently all trials have seemed to confirm the assertion. The Nobert test is a collection of parallel lines, ruled on glass and arranged in groups or bands of gradually increasing fineness. The first group generally contains lines one-thousandth of a Paris line apart—a Paris line being .088815 of an English inch. The number of groups are not the same on all plates, and are not all drawn to the same scale. Thirty groups or bands are sometimes placed on the same plate, and occupy altogether less than one-fiftieth of an inch. Mr. Charles Stodder, in connection with Mr. R. C. Greenleaf, of Boston, recently attempted to resolve the lines on a Nobert test, containing nineteen bands, the first being ruled to one-thousandth of a Paris line, and each band increasing by 500, so that the nineteenth is one-ten-thousandth of a Paris line. With a Tolles one-sixth immersion objective, angular aperture 170 degrees B., eyepiece power 550, they both saw the nineteenth band satisfactorily, and were probably the first to see 112,000 lines to the inch; thus asserting the visibility of such lines, contrary to the theory of some physicists. Dr. J. J. Woodward of Washington lately resolved the seventeenth band on a plate of nineteen bands with a Powell and Leland's one-twenty-fifth and one-sixteenth objectives, a Hartnack immersion, No. 11, and a Wales one-eighth, with amplifier. Up to the time of this observation Dr. Woodward had resolved finer lines than any other observer had seen. More recently, however, Dr. Barnard, President of Columbia College, has experimented with the objectives of Spencer, Tolles, Wales, Nachet, and Hartnack. Remarkable results were obtained with a Wales one-fourth, but it does not appear that he used any stronger power made by this rising optician. Dr. Barnard has satisfactorily seen the lines of the nineteenth band with a Spencer one-twelfth and a Tolles one-sixth, *both dry objectives.* This achievement is fairly beyond any point yet reached in Europe or America. These experiments with low powers prove that in successfully resolving fine lines, less depends on the magnifying power of the objective than on that defining power which results from the skill of the maker. It is certainly gratifying to know that the makers of the best microscopes, Spencer, Tolles, and Wales, reside in this

country, and that many amateur microscopists who, until lately, prided themselves upon the possession of European microscopes, have, in order to see the most minute revelations lately made, been obliged to substitute objectives made in America.

VARIETIES OF CONSTRUCTIVE MATERIAL.

Professor Ansted, F. R. S., in a paper read before the Royal Institute of British Architects, "on the Relations of Geology to Architecture," has presented many points of practical bearing. After speaking of the origin of all rocks yielding constructive material, which may be grouped under three distinct heads, as aqueous, igneous, or metamorphic, he said the mineral composition of rocks is in some cases very simple and evident; in other cases moderately complicated, but easily recognized; in others, again, so complex as to need long experience or chemical analysis to determine its nature. As the enduring power of stone, when exposed to certain influences, depends, in some measure, on mineral composition, this subject is one to which the architect should direct attention. A large proportion of the building material in common use is limestone, more or less pure, and the rest is chiefly sandstone. In the former case carbonate of lime, and in the latter silica is the chief ingredient. Clays unaltered are only used when manufactured into bricks, and the sulphates of lime (gypsum and alabaster) are chiefly adapted for internal use or small ornaments. The granites and porphyries are limited to special uses, owing to their extreme hardness. The varieties of marble may be regarded as varieties of limestone. Slates and slabs, very useful in architecture, and forming a special class of rocks due to metamorphic action, are derived from clay. *Limestones* are simple carbonates of lime, mixed carbonates of lime and magnesia (serpentines), or sulphates of lime. According to their texture, to the cementing medium in the case of the bedded limestones, and in others to the extent of crystalline action or metamorphosis they have undergone, they are available for special purposes. They owe their color to metallic oxyds. When semi-crystallized, and having a grain too fine to be recognized, they are marbles of the common kind, gypsum, or serpentine, according to their chemical composition; when perfectly crystallized, they are statuary marbles or alabaster; when the grain can be recognized, they are freestones; when the grain of the stone is mixed with fragments of shell, they are rag stones, or shell of limestones; when the grain is formed of a multitude of round concentric particles, like the roe of

a fish, they are roe stone or oolites; when the stone is compact, the stratification is evident, and the stones split readily, they are flags. To all these varieties local names are attached in different districts. The limestones in common use in England for architectural purposes are of several distinct kinds, the Portland stones, Bath stones and many others belonging to the oolites, semi-marbles of very compact grain, derived chiefly from rocks of the carboniferous system, the mixed carbonates of lime and magnesia almost entirely from the Permian rocks on the borders of Derbyshire, Nottinghampshire and Yorkshire, as magnesian limestone, and some hard varieties of chalk. Elsewhere, especially in the south of Europe, the cretaceous and tertiary limestones are developed into admirable freestones of exquisite color, very compact and almost non-absorbent. In Italy especially, are found the limestones properly called calcareous tufa (not to be confounded with volcanic tufa), derived from the exposure of waters containing a large quantity of carbonate of lime. On evaporation of the water the carbonate of lime is deposited in a form more or less compact according to the material on which it is thrown down, and the slowness of the deposit. Some very useful building materials are thus obtained, but they are limited to those localities where very large quantities of mineral waters run over the surface. In limestone caverns, and in veins in limestone rocks, the irregular drooping pendants or stalactites, the floor called stalagnite, and the lining walls of the veins are formed in the same way, but the floor is very compact and may be used as marble. Oriental alabaster is of this kind, and it is very abundant in Egypt. The magnesian limestone, generally more crystalline than the oolites are, in proportion to their crystalline state, valuable building materials. They are heavy and hard but work well. The great objection to their use arises from the extreme irregularity of their composition and texture in the quarry. *Sandstones* are more simple in their composition than limestones, as they vary only in the grain, or magnitude of particles of which they are composed, in the nature of the cementing medium, and in the extent to which they contain foreign impurities. There are no crystalline sandstones adapted for architectural purposes, and the metamorphosed sandstones are too hard to be treated as freestones. The color of sandstones is due chiefly to the oxyd of iron, which renders them red or yellow, according to circumstances. The material of all sandstones is silica. *Clays* will not now be considered in detail. They can only be used for constructive purposes when manufactured

into bricks. They are all silicates of alumina, varying in quality according to their mineral composition, but the quantity of alumina necessary to form a sound brick is exceedingly small, and the useful proportions are almost indefinite. *Gypsum* and *alabaster* are pure crystalline sulphates of lime, in somewhat different mechanical conditions. They are neither of them in the state in which the stone is originally deposited. They are found sometimes in veins and sometimes in bands or nodules of large size. Among the very useful materials in the countries where it is abundant, should be mentioned *soapstones* (silicates of magnesia), which, in their quality of resisting fire, are excelled by none. America yields them very largely, and at a moderate cost. They are found in Cornwall, but large blocks for building cannot be obtained of uniform quality, and in sufficient quantity to be used extensively. The gritstones of the carboniferous system are the best stones that can be used for fire-proof buildings. *Granites* of all kinds belong to the class of metaphoric rocks. They were certainly not deposited as they now are, nor were they brought to their present condition by any action of mere heat. Originally, perhaps, of mechanical origin, they have been rendered crystalline by long-continued chemical action, assisted by intense heat and enormous pressure, while in the interior of the earth. In this way have been produced not only the peculiar state of the mass of the rock, but the fissures, and their varied contents, the veins of metalliferous, and other matter that penetrate them, and all the changes they induce in other rocks adjacent. Rocks of this kind are double silicates. *Slates*, once thought to be crystalline rocks, have been produced from clay by mechanical pressure. The fissile character can be given to wax, or to any other substance whose particles are minute, and all the varieties of color and texture, all degrees of fissile nature, all the peculiarities of hardness and resistance may be distinctly traced to the mechanical cause of the phenomenon. It requires however a careful examination of slates in the quarry, and some habit of examining slate quarries, to appreciate the fact that they are so nearly allied to clay pits, and that so narrow a line separates materials apparently so very different. Nothing will be said here of shales, which are transition rocks between clay and slate, of the limestone flags, such as Stonefield slate, nor of such paving stone as the Yorkshire flags. These hardly belong to architecture though occasionally used in construction. They are of a different material, yet are formed in the manner of slates.

Earthquakes in the Sandwich Islands.

The following account of the late earthquake at the Sandwich Islands is from the *Pacific Commercial Advertiser*, of Honolulu, edited and published by Dr. William Hillebrand, who, in connection with Mr. A. Fornander, late editor of the *Polynesian*, made the observations here given.

We left Kealakeakua bay on the morning of the 9th of April, and after a slow, tedious ride of twenty-seven miles over lava clinkers, reached Kapua towards night, where we slept in a thatch house, built by Mr. Charles N. Spencer as an accommodation house, it being just half way between the bay and Waiohinu, and distant from the lava flow about thirteen miles. During the night we could hear the distant noise of the eruption, a peculiar rumbling so different from the roar of the sea or any other noise, that to wake up in the night and listen to its unaccountable utterances tended to create fear with those who for the first time heard it. In the morning several of the party decided to turn back to Kealakeakua, and returned without seeing the grand sight before us. The others, seven in number, not counting native attendants, mounted horses and proceeded on to the flow.

As we approached it the rumbling noise became more and more distinct, and the evidences of approach to some great disturbance of nature more frequent. The ground was covered with what appeared to be cinders, but on examining them we found they were fragments of pumice stone which had been carried by the wind a distance of over ten miles. Mixed with these cinders was Pele's hair, which we found floating in the air, and when it was thick we had to hold our handkerchiefs to our nostrils to prevent inhaling it. Our clothes were frequently covered with it. On reaching an eminence five miles from the stream, we found a group of forty or fifty natives, who were waiting to cross over to Kau, and had been here several days. From this point dense clouds of smoke could be seen rising all along the course of the lava stream, from the mountain side to the sea.

We hurried on and reached the flow shortly after noon, where, from a ridge to the west of it, the whole scene opened before us. Between us and the crater was a valley 500 yards wide and ten miles long, which had recently been overflowed throughout its entire width and length from the mountain to the sea, where it widened to two or three miles. The lava was of the smooth *pahoehoe* variety, from ten to twenty feet deep, and partially cooled over, though flames, smoke and gas escaped from numerous crevices. We

stood on it, though it was hot enough to burn the soles of our shoes. This lava stream originated some ten miles up the mountain, and came down early on the morning of the 7th. It had ceased flowing, the eruption having opened a vent lower down and further south. Beyond this valley, about a quarter of a mile distant, was the pali of Mamalu, a steep precipice, which runs from the mountain to the south point of Hawaii, and forms the west boundary of the table land of Kahuku, a beautiful level plateau, covered with tall grass, affording excellent pasturage for herds of cattle, horses, sheep and goats. About a mile above the road were the farm houses of Captain Robert Brown, who lived there with his family. Near by were the dairy establishment of C. N. Spencer and other dwellings. This plateau was several miles in extent, running as far as Waiohinu and sloping gently off to the sea, and dotted with hillocks.

On Tuesday afternoon, April 7, at five o'clock, a new crater, several miles lower down than that referred to, and about two miles back of Captain Brown's residence, burst out. The lava stream commenced flowing down the beautiful grass covered plateau, toward and around the farm houses, and the inmates had barely time to escape with the clothes they had on, before the houses were all surrounded, burned, and covered with streams of fiery lava, varying from five to fifty feet in depth. Fortunately all the inmates escaped safely to Waiohinu, but how narrow the escape was and how rapid the stream flowed may be inferred from the fact that the path by which they escaped was covered with lava ten minutes after they passed over it.

On ascending the ridge we found the eruption in full blast. Four enormous fountains, apparently distinct from each other, and yet forming a line a mile long, north and south, were continually spouting up from the opening. These jets were blood red, and yet as fluid as water, ever varying in size, bulk and height. Sometimes two would join together, and again, the whole four would be united, making one continuous fountain a mile in length.

From the lower end of the crater a stream of very liquid, boiling lava flowed out and down the plateau, a distance of two or three miles; then following the track of the government road, ran down the precipice at an angle of about thirty degrees, then along the foot of the pali or precipice five miles to the sea, the stream being about eight or ten miles in length, and in some places half a mile wide.

This was the magnificent scene, to see which we had hurriedly left Honolulu, and had fortunately arrived at the right moment to witness

as it opened before us in all its majestic grandeur and unrivalled beauty. At the left were those four great fountains, boiling up with most terrific fury, throwing crimson lava and enormous stones weighing a hundred tons to a height varying constantly from five hundred to six hundred feet. At times these red hot rocks completely filled the air, causing a great noise and roar and flying in every direction, but generally towards the south. Sometimes the fountains would all subside for a few minutes, and then commence increasing till the stones and liquid lava reached a thousand feet in height. The grandeur of this picture, ever varying like a moving panorama painted in the richest crimson hues, no person can realize unless he has witnessed it.

From this great fountain to the sea flowed a rapid stream of red lava, rolling, rushing and tumbling like a swollen river, and bearing along in its current large rocks that almost made the lava foam as it dashed down the precipice and through the valley into the sea, surging and roaring throughout its length like a cataract, with the power and fury perfectly indescribable. It was nothing else than a river of fire from two hundred to eight hundred feet wide and twenty feet deep, with a speed varying from ten to twenty-five miles an hour.

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Night soon came, and with it the scene became a thousandfold more beautiful, the crimson of the fountains and the river doubly rich and brilliant, the lurid glare of the dense clouds and steam that overhung us and the roaring of the crater and the cataract were fearfully grand and awe-inspiring. It was like the conflagration of all London or Paris, as the whole scene extended over a distance of ten miles. Add to this the flashes of lightning and the sharp, quick claps of thunder, and the reader can imagine that a scene was before us that well repaid us for our opportune visit.

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Regarding the rapidity of the stream of lava, since reading accounts of former eruptions, in which it is claimed that the lava flowed forty miles an hour, we must say that it is hardly possible to conceive of a stream flowing with greater rapidity than the cataract and river we witnessed April 10. It reminded us of the Connecticut river in a spring flood, with the stream filled with ice and rushing over the rapids at an impetuous rate. The speed is more likely to have been twenty-five miles an hour than twelve. Where it ran down the precipice, at an angle of about thirty degrees, it was more narrow

and rapid than lower down, where it spread out broader. This was the only stream which reached the sea, and flowed into it a little west of the south point of the island, at a place called Kailikii. It lasted only five days, the eruption ceasing entirely on the night of the 11th or the morning of the 12th.

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Opposite the point of coast where the lava reached the sea a small conical island was thrown up in the sea, about a mile distant from the shore, consisting of mud and sand, and emitting steam from its summit. This island has become joined to the mainland by the lava flowing from the new eruption. As the lava entered the sea, clouds of steam and smoke rose up, and flames of bluish fire were emitted, rising from the water to a height of from ten to twenty feet. During the night we were at the volcano the air was highly charged with sulphur, gas and electricity, and frequent flashes of lightning were seen directly over the lava stream, accompanied with short claps of thunder. These flashes were also observed less frequently further up the mountain.

Two kinds of lava were erupted during the flow. It commenced with a stream of smooth, glossy lava, known here as *pahoehoe*, which was followed by the thick, dirty kind, called *aa*. Kahuku farm was nearly covered with the latter, which branched out into four wide streams, covering a space of four miles wide and long. This was followed again by the liquid or *pahoehoe*, which ran into the sea, and continued till the eruption ceased. About 4,000 acres of good pasture land were destroyed, besides which the lava ran over an immense district of worthless land.

On the night of the 6th, prior to the eruption, there was a shower of ashes and pumice stone, which came from this crater, and covered the country to the distance of ten or fifteen miles each way. Generally the ashes were not more than one or two inches in depth, but in some places were found to be fifteen. The pumice stone was very light, and appears to have been carried by the wind a great distance. Pieces two and three inches in size floated ashore at Kealakekua bay, forty-five miles distant.

The roaring of the crater was a novel feature to those who had never visited an eruption before. It was caused by the rocks thrown out from the crater and the grinding or crushing process of the *aa* as it moved along. This *aa* flow appears composed of half-melted lava, and as it is pushed along piled up sometimes fifty or even a hundred

feet high, presenting the appearance of a railroad embankment, the sides having an angle of about forty degrees, down which the lava stones keep rolling. This stream generally moves along slowly, but when the quantity of liquid lava, which floats and carries along the *aa*, is abundant, it moves from one to four miles an hour. What makes the difference between the dry *aa* lava and the liquid *pahoehoe*, which flows like water, is an interesting subject of inquiry that has never been settled. They both flow from the same craters, one giving place to the other in turns. Our own opinion is that the smooth liquid variety obtains its character by long fusion, while the *aa* variety (which appears like half-melted stones and dirt mixed together) consists of the interior surface of the earth torn off and thrown out during the eruption. An examination of the various *aa* streams tends to confirm this theory.

Besides the dwelling and premises, which were completely burned and covered up ten feet deep by the lava, Mr. Brown lost about 100 head of cattle and other parties about 150 head. These cattle appeared to be paralyzed on the approach of the lava and made no effort to escape. It is difficult to estimate the loss of property in Kahuku, but it may be roughly set down at from $10,000 to $15,000. The houses destroyed were not expensive, the main loss being in land and stock.

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Respecting the weather during March it may be added that it was of the same stormy character as has prevailed all over the western hemisphere, including north and south Pacific. The quantity of rain that has fallen on the mountains of Hawaii has also been large, but to what extent these have affected the internal fires and produced the earthquakes and eruptions must remain only a matter of conjecture. The thermometer during the same month showed no unusual fluctuation, ranging from sixty-eight to seventy degrees at sunrise, and eighty-three to eighty-four degrees at noon, with considerable regularly.

The same writer commenting on the earthquakes says as follows:

At about ten, A. M., on the 28th of March a series of earthquakes began which continued at intervals with varied severity for over a month. At Kona as many as fifty or sixty distinct shocks were felt in one day; at Kau over three hundred in the same time, and near the great crater of Kilauea the earth is represented as having been in a constant quiver for days together, with frequent vigor-

ous shocks that would send crockery, chairs, lamps, etc., spinning around in not a very pleasant way. Mr. J. Porter, the proprietor of the Volcano House, says he endured this for several days, as long as he could, till one night about eleven o'clock Pele sent one of Rodman's twenty-inch shot, with a well directed aim, that struck the ground directly under his bed; when he jumped and ran, where or how he hardly knew, but he found himself after a while in the woods, safe and sound.

One can readily imagine the state of nervous excitement produced by the continual swaying of the ground, with an occasional shock like that produced by a heavy rock striking the crust beneath him. A lady who spent two weeks in this shaky region says that she put her ear down to the earth during one of the "ground swells," and could distinctly hear the rushing and roaring of the lava waves beneath the surface like the surging of waves in a storm. It was such a scene as unstrung the firmest nerves. Residents of Kau inform us that over 2,000 distinct shocks occurred there between the 28th of March and the 11th of April, averaging over 140 a day for two weeks.

The earthquakes continued to increase in severity from March 28 till April 2, when about four o'clock in the afternoon one took place that shook down every stone wall, and nearly every stone, frame and thatch house throughout Kau, and did more or less damage on every part of Hawaii, while it was felt very sensibly at Maui, Molokai, Oahu and Kauai, the latter island three hundred miles distant from the crater. Every church in the district named was destroyed, with perhaps a single exception. The shock was so severe that it threw persons from their feet, and even horses and animals were served in the same way. A gentleman riding on horseback in Kau found his horse lying flat under him before he could think of the cause. The effect of the shock was instantaneous. Before a person could think, he found himself prostrate on the ground. The large stone church of Waiohinu went down in the same way; a sudden jerk, the walls crumbled in and the roof fell flat, all the work of ten seconds.

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Respecting the course or direction of the shocks we have made many inquiries. Those felt here on Oahu have mostly been undulating, with a wave-like motion. On Hawaii they had three distinct characteristics: the undulating, with the motion generally from the north-

west to southeast; second, the sudden, short, sharp jerking shock, occupying hardly two seconds, and third, a thumping, like a boulder of rock thrown suddenly against the crust of earth beneath you, and as suddenly falling down. Each kind was frequently accompanied with a rattling noise, like distant thunder or artillery, more or less distinct. The lighter shocks generally had no accompanying noise. We experienced one of these thumping shocks while asleep near the crater on the night of the 10th. It sounded precisely as if a cannon ball had struck the floor under us, and then rolled along the verandah. It started us out of a sound sleep. At Kau the motion was often from south to north.

Dr. William Hillebrand visited the crater of Kilauea and the scene of the mud flow, and has published a very interesting report of his observations, from which the following extracts are taken. Many persons in the United States have visited the island of Hawaii and explored the crater of Kilauea. To such the localities named will be familiar and the account full of interest:

"The ground around the crater of Kilauea, particularly on the eastern and western sides, is rent by a great number of fissures; one near the Puna road more than twelve feet wide and very deep. Others of lesser size run parallel to and cross the Kau road so as to render travel on it very dangerous. The look-out house is detached from the mainland by a very deep crevasse, and stands now on an isolated, overhanging rock, which, at the next severe concussion, must tumble into the pit below. Many smaller fissures are hidden by grass and bushes, forming so many traps for the unwary. The Volcano House, however, has not suffered, nor is the ground surrounding it broken in the least. From the walls of Kilauea large masses of rock have been detached and thrown down. On the west and northwest side, where the fire had been most active before the great earthquake of April 2, the falling masses probably have been at once melted by the lava and carried off in its stream, for the walls there remain as perpendicular as they were before; but that this part of the wall has lost portions of its mass is shown too evidently by the deep crevices along the western edge just spoken of, and the partial detachment in many places of large prisms of rock. But it is on the east and northeast wall particularly that the character of the crater has undergone a change. Along the descent on the second ledge large masses of rock, many more than one hundred tons in weight, obstruct the path and form abutments to the stone pillars; small buttress hills,

similar to those observed in front of the high basaltic wall in Koolau, Oahu. So, also, in the deep crater itself, the eastern wall has lost much of its perpendicular dip, and has become shelving in part.

The crater itself was entirely devoid of liquid lava; no incandescence anywhere; pitchy darkness hovered over the abyss the first night. I say the first night, because, during the second night of our stay, between twelve and one, A. M., detonations were heard again, and light reappeared for a short time in the south lake. White vapors of steam issued from the floor in a hundred places, but of those stifling, sulphurous and acid gases formerly so overpowering in the neighborhood of the lakes and ovens, only the faintest trace was perceived here and there. The heat was nowhere so great that we could not keep our footing for a minute or more, although in many places it would forbid the touch of the bare hand. The great south lake is transformed into a vast pit more than five hundred feet deep, the solid eastern wall projecting far over the hollow below, while the remaining sides are falling off with a sharp inclination, and consist of a confused mass of sharp *aa*. More than two-thirds of the old floor of Kilauea has caved in and sunk from one hundred to three hundred feet below the level of the remaining floor. The depression embraces the whole western half, and infringes in a semi-circular line on a considerable portion of the other half. It is greatest in the northern, and rather gradual and gentle in its southern portion. Entering upon the depressed floor from the southern lake, it was some time before we became fully aware of its existence. It was only on our return from the northwest corner, where it is deepest, that there presented itself through the mist in which we were enveloped a high wall of three hundred feet of grotesque and fantastic outlines. At first we were quite bewildered, fancying that we beheld the great outer wall of the crater. On nearer approach, we soon satisfied ourselves that this singular wall represented the line of demarkation of a great depression in the floor of the crater, a fact that surprised us the more, as a bird's eye view from above had altogether failed to apprise us of its existence.

As we had been informed that the principal activity of the crater before the great earthquake had been in the northwest corner, we proceeded in that direction on leaving the south lake. Having arrived at about the middle of the depression, a considerable rise in the ground presented itself no our left, to the west. Having ascended this, we found ourselves at the brink of a fearful chasm, which fell off on our side with a beetling wall to the depth of several hundred

feet and extended about half a mile from north to south. Very hot air rose from it. Around it, toward its northern extremity, the lava is thrown up into an indescribable confusion; pile upon pile of *aa*, gorge and ridge by turns.

The caving in of the floor seemed to be still in progression; for twice during our exploration of the crater our nerves were disturbed by a prolonged heavy rumbling and rattling noise, as from a distant platoon fire of musketry, coming from the northwest corner.

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Thus far as to what we have seen. Now allow me to relate what I learned from Kaina, who has resided near the volcano without interruption for the last five months, and whose strong nerves sustained him during the fearful catastrophe introduced by the earthquake of April 2d. He and the Chinaman who keeps the house were the only persons who remained at Kilauea. He says for two months preceding the first shock, viz., from January 20 to March 29, the crater had been unusually active, eight lakes being in constant ebullition and frequently overflowing. During all this time (the date of its first appearance could not be ascertained exactly) there was in the northwest corner a "blow-hole," from which, at regular intervals of a minute or less, with a roaring noise, large masses of vapor were thrown off, as from a steam engine. This ceased about the 17th of March. At the same time the activity of the lakes became greatly increased, and Kaina anticipated mischief. March 27th the first shock was perceived. Two days later Mr. Fornander found the bottom of the crater overflowed with fresh lava and incandescent.

Thursday, April 2d, at a few minutes past four P. M., the big earthquake occurred, which caused the ground around Kilauea to rock like a ship at sea. At that moment there commenced fearful detonations in the crater; large quantities of lava were thrown up to a great height; portions of the wall tumbled in. This extraordinary commotion, accompanied with unearthly noise and ceaseless swaying of the ground, continued from that day till Sunday night, April 5th; but from the 1st the fire began to recede. On Thursday night it was already confined to the regular lakes; on Saturday night it only remained in the great south lake, and on Sunday night there was none at all, Pele had left Kilauea. The noises now became weaker and were separated by longer intervals. By Tuesday quiet reigned in Kilauea. On that afternoon the lava burst out at a distance of forty miles southwest, in Kahuku.

The Great Fissure near the Puna Road.

In Kapapala we were told that fire had been seen several nights in a southeast direction and that natives had reported flowing lava there. We rode over on the morning of April 20. At a distance of five miles from Mr. Reed's dwelling, where the Puna road turns off from the Kilauea road, heavy clouds of white vapor were seen to issue from the bush, which sparsely covered the *pahoehoe makai* of the road. Half an hour's ride brought us up to the place, but we were obliged to leave our horses some distance before reaching the spot on account of fissures. After having crossed a number of them, heading for the heaviest cloud of vapor, we at last came to a deep crevasse in the *pahoehoe* at least twenty-four feet in width, no bottom visible. It narrowed and widened out in places, but nowhere was less than eight feet wide. Its length we estimated at 400 feet. Parallel with this great crevasse, constituting a belt about 600 feet in width, were a number of smaller ones on each side, diminishing in size with distance from it, from six feet to a few inches. From the larger openings in the former heavy white columns of hot steam issued, which had a decidedly alkaline smell. Smaller jets of vapor, to the number of thirty, rose from the smaller fissures. We could not discover fire in any place, but it is very probable that during dark nights the reflex of the underlying lava should be thrown up, for as the steam did not seem to contain combustible material it is unlikely that the light seen should have been produced by it. The mean direction of all the fissures was northeast nine degrees north, southwest nine degrees south, or nearly the direction of a line connecting Kilauea with Waiohinu and Kahuku. The distance of these fissures from Kilauea is thirteen miles.

Kapapala.

As in this district the earthquake of April 2 culminated to its greatest intensity, so as even to rend in twain the framework of a mountain side and hurl down on the plain a portion of its flank, it is necessary to give a short description of the country in order to insure a proper understanding of the disturbance. The locality in question is that comprised between the ranch station of Messrs. Reed and Richardson, on the east, and Mr. F. Lyman, on the west, a distance of five miles. The government road connecting these two places runs through a fine grassy plain, which has a very gentle fall towards the sea, its elevation being about 2,000 feet. Into this plain project from

the slope of Mauna Loa three parallel hills, or spurs, each about one mile in length, and from 800 to 1,000 feet in height. They include two broad valleys between them. The upper portions of these valleys rise with a steep incline toward a ridge which runs at right angles with the spurs, and is covered with a dense pulu forest, which extends far up the gentle slope of the dome of Mauna Loa. In the second one of these valleys, that next to Mr. Lyman's, the so-called mud flow took place; but very extensive landslides, confined simply to the loose earth and conglomerate, also occurred in the other valleys.

The ground around Reed & Richardson's station is torn up into numerous small cracks and fissures, running in every direction. Some are large enough to engulf horse and rider, a fact which actually occurred a few days after the earthquake. A large cistern, built in solid masonry and covered with an arched stone roof, was rent to pieces, and the roof entirely broken away. Not a single stone fence is standing; their places are indicated by flat belts of stone on the ground. The dwelling house, a good wooden frame one, exhibits a wrench across its roof, so that the gutters empty themselves in the sitting room; the cook house is thrown off its foundation; other outbuildings are completely overturned; and of the grass houses, some are smashed down, others greatly inclined. But all these signs of destruction are thrown into the shade by the grandeur of the force which shook off the side of the pali, burying, in a minute, thirty-one human beings, many hundred head of cattle and entire flocks of goats, and ending, four miles from its beginning, in a mighty river of mud. Before reaching this mud flow, from Reed's house, we passed two considerable streams of muddy water, of a reddish yellow color, emitting a strong odor of clay, such as may be perceived in potteries. Both streams have their origin in the land slide of the first valley. When we passed them again, two days later, they had nearly disappeared. They evidently owed their origin to the drainage of the fallen mass. The mud flow is met with three miles from Reed's; it projects itself from the spurs of the hills two miles down on the plain; begins at once with a thickness of six feet, which, toward the middle, where it forms a small hill, rises to thirty feet, averages about three-fourths of a mile in width, and contracts toward its end. From this end a long cue of boulders bears witness to the violent action of a torrent which shot out of the mud after it was deposited, and which has since perpetuated itself in a stream of some size, quite muddy, and emitting the above mentioned

pottery odor, when we saw it first on April 20, but perfectly clear and inodorous when we passed it three days later. A little higher up a koa grove gives still stronger evidence to the strength of the propelling force. The trees first seized are snapped off and prostrate, yet the mud in that place is only a few feet deep. The mass itself is nothing but the loose, red soil of the mountain side, with a good sprinkling of round boulders, with here and there stumps of trees, ferns, hapuu and amaumau and entire lehua trunks. Near the lower end a vigorous, healthy taro plant stood erect in the mud, as if it had been planted there. From its sides protruded portions of the bodies of many cattle and goats, overwhelmed in their flight; a gain of one second in time might have saved them. The surface of the mud in this lower course was rather smooth, as if it had been forced down by the agency of water, and it was still so soft that the feet sank deep into it.

After we had flanked it for some distance along the side of the hill the mud became solid enough to bear our weight, and we walked upon it to the head of the pali. The surface gradually became more rough; the boulders increased, and detached portions of earth and stone were scattered beyond its borders, which also flattened out gradually. The ascent soon became steep, and here, on a short spur, just in the middle of the mud, stands a native house on an island of grass and taro, flanked by two trees. A poor woman who happened to be in it at the time of the outbreak escaped the awful fate which doomed the remaining members of her family, and was removed from her perilous situation a few days after, when the crust had become solid enough to bear a man's weight.

As we went on the mass became more rough and hard, tree trunks and boulders increased, even angular rocks appeared, until at last the mud ceased entirely and gave place to a sea of huge rocks, all angular and exhibiting fresh fractures, large trunks of trees crushed between and under them and streamlets of fresh, clear water meandering between them. This continued for the last 300 feet of rise and ended in a perpendicular wall of solid rock some twenty feet high, after having climbed which we reposed under the refreshing shade of tall fern trees, for we had entered at once the great pulu forest. Seated on the trunk of a prostrate tree we could survey the whole field of devastation we had just traversed. Immediately at our feet the rocky framework of the pali was torn up and its contents turned topsy turvy in dire confusion. The rocky wall we had just climbed

continued itself until it reached the sides of the two flanking hills. A perpendicular cut in the side of the latter laid open some forty feet of red earth and conglomerate. Looking behind us we saw that the rock we were resting on was separated from the mountain by a deep crevasse, parallel to the wall and only partly visible as it extended under the dense trees. To our left a clear sparkling mountain stream leaped in a bouncing cascade over the crag, and after losing its course amid the maze of rocks, gathered itself again, flowing over the solid bed rock in a deep gorge cut in the mud. This stream had existed here before, but ere it reached half down the pali became lost in the soil. It can easily be imagined what an amount of subsoil water must have been deposited here. Bearing this in mind and the great depth of soil and conglomerate on this slope, as indicated by the cuts in the hill sides, there seems to be no great difficulty to explain how such enormous masses of earth, at first propelled horizontally through the air, hurled down the valley by the tremendous force which tore off the side of the mountain, should then have been seized by the propelling of the now liberated subsoil water and carried in a mighty stream from beyond the place where at first they were deposited.

On returning, we concluded to reach and follow the ridge of the hill flanking the stream on our left. Having arrived there, we could survey the extent of the land slides on the opposite side of the hill, which were considerable. From this place, our guide pointed out to us a human figure in the distance, moving slowly over the dreary field. It was a husband searching for the body of his wife. Our guide, himself, poor fellow, mourned the loss of a wife, two little boys and both parents. All slept their long sleep under that field of desolation. Following the crest of the hill, still covered with grass and wood, we were startled by the number of fissures and crevices intersecting it in every direction. In some places, one was tempted to say that more space was occupied by them than by the solid crust.

The direction of the solid rock wall and the *crevasse* in the forest is northeast by north to southwest by south, nearly parallel to a line connecting Kiaiuea with the lava outbreak in Kahuka. The stream running from the mud-flow is likely to remain permanent, as it is a continuance of the mountain stream above, and now runs upon exposed solid bed rock.

All this destruction was the work of the great earthquake of April 2. During the five days preceding it over 1,000 shocks had been counted. On that afternoon, Mr. Harbottle, at Reed's, with his

men, was driving cattle across the hill toward Hilo, when suddenly the earth shook violently, and a great detonation was heard behind them. Horses and cattle turned round involuntarily. The whole atmosphere before them was red and black. In a very short time this subsided, some say in one minute, others in five minutes; but a black cloud continued to hover over the scene for some time. A native who resided less than half a mile from the scene, and who had friends living on the hill, found courage enough to run to it half an hour after the occurrence. He thrust his hand in the mud and found it cold.

From that Thursday to Sunday the earth constantly rocked and swayed, the hills seemed to alternately approach and recede. Most people became seasick. Strange roaring and surging noises were heard under the ground. When the ear was applied to the earth it would often receive a distinct impression as if a subterranean wave struck against the earth's crust.

Mr. Jornander writes as follows regarding the tidal wave:

At Keauhou, the following results of the earthquake on Thursday have been reported. Mr. Stackpole, who had charge of the place, had been up to the Volcano house during the day, and was returning in the afternoon. While descending the pali to Keauhou, the first shock occurred, precipitating an immense amount of earth, stones, and boulders down the pali after him. Escaping these, he arrived on the plateau below the pali, and looked in the direction of the village of Apua, but not a house was to be seen! He then rode down to the edge of the plateau, from whence Keauhou ought to have been in sight, but nothing of it could be seen. Descending to Pahoehoe, he met the men working at Keauhou running up mauka, who reported that nothing was left of Keauhou; that immediately after the earthquake the sea had rushed in and swept off every dwelling and store house and all their contents, and that they had barely escaped with their lives. There were some 167 bales of pulu in store, ready for shipment, all of which was swept away. They represent that the sea went up as far as the two basaltic columns indicating the road down to Keauhou, a depth of wave at least forty to fifty feet.

At Punaluu, at the moment of the shock, it seemed as if an immense quantity of lava had been discharged into the sea some distance from the shore, for almost instantly a terrible commotion arose, the water boiling and tossing furiously. Shortly afterwards a tremendous wave was sweeping up on the shore, and when it receded

there was nothing left of Punaluu. Every house, the big stone church, even the cocoanut trees, all but two, were washed away. The number of lives lost is not yet ascertained. All who were out fishing at the time perished, and many of those ashore. A big chasm opened, running from the sea up into the mountain, down which, it is said, lava, mud, trees, ferns and rocks were rushing out into the sea.

The same wave that swept away Punaluu also destroyed the villages of Ninole, Kawaa and Honuapo. Not a house remains to mark the site of these places, except at Honuapo, where a small "hale halawai," on the brow of the hill, above the village, stood on Friday last. The large cocoanut grove at Honuapo was washed away, as well as that at Punaluu. A part of the big pali at Honuapo, on the road to Waiohinu, had tumbled into the sea, and people coming from thence are now obliged to take the mountain road through Hilea-uka.

"The sea swept Kaalualu on Thursday last, as it had swept Honuapo and the other places along the coast, washed away several houses and killed a number of people, how many is not yet known. The earth has been shaking almost constantly and severely every day and night. A large land slide had occurred on the west side of Waiohinu valley, near where Swain's tannery was formerly situated. Fire had been seen in the mountains above, but none had come down on the low lands between Kahuku and Waiohinu when they left on Monday morning. A large hole, sixty feet in diameter, had opened on the flat below Kahuku, with no bottom visible from the brink of it, and emitting quantities of sulphuric vapor.

I have just been told an incident that occurred at Ninole during the inundation of that place. At the time of the shock, on Thursday, a man named Holoua and his wife ran out of the house and started for the hills above; but remembering the money he had in the house the man left his wife and returned to bring it away. Just as he had entered the house the sea broke on the shore, and, enveloping the building, first washed it several yards inland and then, as the wave receded, swept it off to sea with him in it. Being a powerful man, and one of the most expert swimmers in that region, he succeeded in wrenching off a board or a rafter, and with this as a *papa heenulu* (surf board) he boldly struck out for the shore and landed safely with the return wave. When we consider the prodigious height of the breaker on which he rode to the shore (fifty, perhaps sixty feet), the feat seems almost incredible, were it not that he is now alive to attest it, as well as the people on the hill side who saw him.

The latest advices from Hawaii state that the island is still shaking and quivering, making forty-one days of earthquakes. Nothing new as yet regarding lava flows, although the inhabitants feel confident another flow must take place before quiet will be restored.

Adjourned.

September 17, 1868.

Professor S. D. Tillman in the Chair; Mr. C. E. Emery, Secretary.

New Petroleum Lamp.

Mr. Rugg, of Sing Sing, N. Y., exhibited a petroleum lamp burner, in which a perforated plate on each side of the wick separates the air and causes the flame to burn some distance above the metal tube, and so the metal part of the glass chimney is not heated in the least; an even and free current of air is kept up all the while, and the air being diffused in small streams, the flame is not flickering, but very steady.

Dr. J. B. Rich remarked that the steadiness and brilliancy of the flame of this lamp made it preferable to daylight for microscopic purposes.

New Mode of Preserving Wood.

Mr. Franklin presented a number of specimens of wood impregnated with resin under pressure. The inferior woods, he said, such as hemlock, pine, oak, chestnut, birch, maple, ash, spruce, hickory, etc., are by this process transformed into costly and valuable ones, resembling rosewood, black walnut, ebony, mahogany, etc. The rapid destruction of our forests, owing to the increasing demand of manufactures, railroads, and the short-sighted policy of settlers in clearing off their land, with little or no reference to the future, has for some time attracted public attention to the necessity of providing against the diminution of the supply of wood. Economists foresee the time when our once densely wooded hills and plains will become as barren as those of Greece, if the consumption of wood goes on at the present rate, and no means are taken to make up the loss.

There are two ways in which this can be done. The forests can either be replenished, as is done in some parts of Europe, or the wood used for railroad ties, buildings, dock piles, etc., may be rendered indestructible, and thereby lessen the demand upon the forests. This plan has often been attempted, with varying success. The latest in

this country is that of the American Wood Preserving Company, of this city, who claim to have invented a process by which the fibers of the softest and most easily worked wood can be rendered as indestructible as stone, and more enduring than iron. The process is simple and inexpensive. It consists merely in filling the pores of the wood with a preparation of resin, invented by Mr. Heineman, which, it is claimed, will prevent the entrance of water and matter soluble in it, which ordinarily facilitates the decomposition of organic substances. The process is also a protection against the destruction produced by worms, and also against dry rot, so frequently, and at times so rapidly, destructive to wooden ships, to the beams of many of our edifices, to our bridges, railroad ties, etc., causing annual losses of millions of dollars and hundreds of human lives.

The most common woods, such as pine, birch, hemlock, etc., which have been subjected to this process, assume the appearance of the more costly varieties of woods, and can be used instead of these for the manufacture of furniture. Even after saturation the wood is easily worked by ordinary carpenters' tools. It has all the beauty and firmness of the fine woods, and takes as clear a polish.

If the process is really capable of all that is claimed for it, it cannot fail to be very valuable. It will be curious if the art of preserving wood, so well known to the ancient Egyptians, should be rediscovered in this age and in this country. Yet this seems probable. The specimens of wood from the pyramids, now in the Egyptian museum, have the dark-brown appearance of the pieces subjected to Mr. Heineman's process, and even the most searching microscopic test fails to discover any material difference. Of course the practical value of the modern process can be determined by actual experience only. If Mr. Heineman has really invented a process by which the quality of the cheaper kinds of wood can be improved, and the fibers at the same time made impervious to moisture, and, therefore, indestructible by ordinary influence, he has rendered our commercial interests a valuabe and important service. Every day brings some new use for wood. It is demanded for the thousands of miles of railroads building in all parts of the country, for docks, for ships, for buildings of every description; for many kinds of machinery and implements of agriculture. These uses require an immense supply of wood, and the demand grows greater every year. The importance of a process by which wood may be improved and rendered less liable to destruction, can, therefore, be easily appreciated.

Mr. T. W. Heineman described his process. The wood is placed in a tank at a pressure of 150 pounds; resin is put in in a solid state; water is then introduced, and when the temperature reaches 212 degrees, the water is converted into steam, which softens the wood and opens the pores. When the heat reaches 275 degrees, the resin gradually melts and falls to the bottom. The pressure is then kept at 145 pounds. A piece of wood twenty-four feet long, requires some sixty hours to become thoroughly impregnated. The price of the resin is about one cent a pound.

Mr. Dudley Blanchard said that some twenty-five years ago, he saw some wood boiled in rosin for pump-tubes, and they were very durable.

William Swinton, Esq., author of "The Army of the Potomac," and other works, read the following interesting paper on

Earthquakes.

The late earthquake which shook the western coast of South America, lacks no incident of calamity or touch of the terrible to render complete the afflictive picture of utter horror and elemental wreck.

None of the more direful manifestations of nature's energies; tempest, whirlwind, thunder or flood, is so calculated to affright the imagination as are these throes of the planet upon which we live; and perhaps there is for this (apart from the appalling results that ofttimes attend these phenomena), a reason in the very nature of the human mind. It has often been noted that the *unexpected* is a main element in the horrible. Now, there is no conviction more deep-seated than that, instinctively entertained by mankind, of the firm-based, solid structure of the earth. When, therefore, it comes to pass that its stout-ribbed immobile fabric is seen to quake and shiver, and the surface on which we mortals so securely tread, treacherously to yield like the unstable sea, the sudden shock given to our firm faith cannot but confound the reason and awaken a deep dismay. Even when the tremor is harmless it is alarming, but the dread is immeasurably increased when there occurs one of the greater convulsive travailings of nature, such as that which last month overwhelmed the seaside cities of Peru, Ecuador and Chili.

It is a tragic tale, commingled of all horrors, that comes up to us from that unhappy land. We hear of scores of cities overturned, burying tens of thousands of the inhabitants beneath their ruins, and then deluged by the swollen and angry sea; we are told of the

affrighted populations fleeing from present wrath, without food or shelter, to the mountains; of the whole coast for several thousand miles shaken with horrible commotions; of direful subterranean vomitings; of mephitic vapors filling all the air; of violent volcanic eruptions; while to complete the picture of horrors we have the vision of the yawning earth rendering up its old-time burial places, and disclosing the ghastly files of antique dead. It is no wonder that in these seeming death-throes and mortal agonies of nature, men should have read the omens of that day of doom whereof the mediæval hymn sings,

> "Dies irae, dies illa.
> Solvet sæclum in favilla."

Well, where the uninstructed mind leaves off, fatigued at the thought of so much calamity and puzzled to reconcile such scourges with the conception of a benevolent Creator, science appears, laboriously studies these strange phenomena in terrestrial physics, succeeds at length in connecting them with the general cosmic plan, and, last triumph of divining power, boldly proclaims that the earthquake itself, desolating as are sometimes its effects, is but a fresh illustration of the great law of compensation, but an incident in a vast system of action to which we owe the very ground we stand upon, and the very land we inhabit.

In order to make this clear, it will be necessary briefly to recall some elementary facts in that science which investigates the changes that have taken place, and are still taking place, in the structure of our planet.

It is a matter of observation that, everywhere around the coast line of every continent, the sea is constantly at work warring against the land, crumbling away its edges, grinding it to powder, and carrying the detritus away and spreading it out over its own bottom. This process is slow, but it goes on *forever*, and the result is, that, in time (that is, in the secular time in which geology works), the structure of continents is entirely worn away, and new ones are formed out of the ruins of the former ones. It is quite certain that our present land was formerly the bed of the sea, and that continental masses once reared their forms where now rolls the "deep and dark blue ocean." Now, rightly estimating this mighty power of the aqueous agents which incessantly labor to reduce the inequalities of the earth's surface to a level, it is easy to see that, if they went on unopposed, they would at length "clear away and spread over the bed of the ocean all

our present existing continents and islands," and, indeed, they have been at work long enough to have, if unopposed, produced this very result.

It is the earthquake and the volcano which places themselves in opposition to this destructive tendency; so that we may regard the igneous agents as in constant antagonism to the aqueous agents, the latter laboring incessantly to obliterate the land, while the former are equally active in restoring it. What are these igneous agents, and what is their source?

It is a fact perfectly assured that, in proportion as we descend into the earth, the heat augments, and the deeper we go the hotter the earth is found to be. This is proven by numberless observations that have been made, not only in the temperature of the air in mines, but in that of rocks and in the water issuing from them. In boring artesian wells the water always comes up hot, and the deeper the boring the hotter the water. In the famous well in Paris at La Grenelle, the water rises from a depth of 1,794 feet, and its temperature is eighty-two degrees Fahrenheit, which is almost that of the equator. The same thing appears in natural hot springs, as for instance that of Arkansas, which is scalding hot, and shows a continuous temperature of 180 degrees. This increase is estimated at about a degree of the thermometer additional warmth for every ninety feet of additional depth; or about fifty-eighty degrees per mile. "At twenty miles depth," says a distinguished physicist, "according to this rate, the ground must be fully red hot; and at no such very great depth beyond, either the whole must be melted, or only the most infusible and intractable kinds of material, such as our fire-clays and flints would prevent some degree of solidity."

Now, though geology does not say that there may not be a solid central mass in the interior of the earth, "kept solid in spite of the heat by the enormous pressure," it does say that an immense range of terrestrial phenomena compels us to conclude that beneath the crust of the earth there is a sea of liquid fire, on which the continents and the land underneath the ocean are floating. This central fire is not only incandescent matter, but it is matter in a state of energetic elasticity, continually reacting upon the structure of the earth, and making itself felt more or less palpably; sometimes producing violent undulatory motions, and at other times breaking through the crust and vomiting forth lava and the central fluid. The former of these commotions are styled earthquakes; the latter, volcanoes: there is

little doubt that they have a common origin, and, as has already been observed, it is their function to counteract the leveling effect of water, partly by heaping up new matter in certain localities, and partly by deepening one portion, and forcing out another, of the earth's envelope. It remains to see in what manner this is done.

In a paper as profound in its views as it is luminous in its statement, Sir John Herschel has indicated the philosophy of these divulsions and upheavals, and we cannot do better here than epitomize his statement. The land, as has been seen, is perpetually wearing down, and the materials are being carried out to sea, thinning toward the land, and thickening over all the bed of the sea. What must happen? If the continents be lightened, they will rise; if the bed of the sea receive additional weight it will sink. It is impossible but that this increase of pressure in some places, and relief in others, must be very unequal in their bearings; so that at some place or other this solid floating crust must be brought into a state of strain, and if there be a weak or a soft place, a crack will at last take place. When this happens, down goes the land on the heavy side, and up on the light side. This is exactly what happens in earthquakes. We should naturally expect that such cracks and outbreaks would occur along those lines where the relief of pressure is the greatest, and also its increase on the sea-side; that is to say, along or in the neighborhood of the sea-coast, where the destruction of the land is going on with most activity. Now, it is a remarkable fact in the history of volcanoes that there is hardly an instance of any *active* volcano at any considerable distance from the sea-coast, while it is to be observed that the favorite sporting places of earthquakes are the regions covered by the great chains of volcanic cones.

That earthquakes operate to raise the land-masses is not a mere matter of speculation, but a fact of repeated observation. In 1822, in a single night (Nov. 19), the whole coast line of Chili for a hundred miles about Valparaiso, with the mighty chain of the Andes, was hoisted at one shock from two to seven feet above its former level, leaving the beach *below* the old low-water mark high and dry. In 1819, in an earthquake in India, in the district of Cutch, bordering on the Indus, a tract of country more than fifty miles long and sixteen broad was suddenly raised ten feet above its former level. And again, in 1538, in the convulsion which threw up the Monte Nuovo, the whole coast of Pozzuoli, near Naples, was raised twenty feet above its former level, and remains so permanently upheaved to this day.

There are hundreds of the like instances on record, and no doubt, when we come to get full scientific accounts of the late convulsion, it will be found that parts of the coast of South America have been raised above their former level.

Such is the way in which earthquakes do their work, and they are *always* at work. According to Humboldt, there is not a day in which the earth is not shaken by these commotions; so that the state of perpetual movement is the normal condition of the surface of our globe, and, if we had apparatus sufficiently sensitive, we should doubtless detect this constant movement. And, indeed, already astronomers complain that their instruments betray, by inexplicable perturbations, the instability of the crust that supports them.

It is true that over by far the larger part of the globe these agitations are either slight, or else absolutely imperceptible, so that we consider the greater portion of the earth as motionless; but there are other countries that have again and again been rudely shaken by violent and destructive convulsions. These are the true regions of the earthquake and volcano, and modern physical geography has made such progress as to mark off a certain number of extensive districts or zones in which the shocks are simultaneous. Among these may be mentioned the Atlantic district, that of Central Asia, and that of the Pacific ocean.

Of these great regions, the zone embracing the Andes of South America is one of the best defined, and it is that divulsed by the late earthquake waves. It extends from the southward of Chili to the northward of Quito, from about latitude forty three degrees south, to about two degrees north of the equator. In this region, comprehending forty-five degrees of latitude, or above 3,000 miles, there is a great chain of volcanic cones, arranged in a linear direction. In Quito, Peru and Chili there are twenty-six of these in activity, and nearly as many more extinct ones, any one of which, as geologists tell us, may at any moment break out afresh. In this whole region earthquakes of more or less violence are of very frequent occurrence. Boussingault declares his belief that if a full register had been kept of all the convulsions experienced in this zone, it would be found that the trembling of the earth had been incessant. Nor is the frequency of these South American earthquakes more extraordinary than the duration of the shocks. Humboldt relates that on one occasion, when traveling on mule back with his companion Bonpland, they were obliged to dismount in a dense forest and throw themselves on

the ground, the earth being shaken uninterruptedly for upwards of a quarter of an hour with such violence that they could not keep their legs.

It is much to be hoped, for the sake of science that we may have full and accurate data respecting the late South American earthquakes. In general there is a great deficiency of reliable information regarding such phenomena. There are very few that would have the nerve and mental balance to imitate the *savan* Boussingault, who, in one of the South American earthquakes in 1827, sat tranquilly, marine chronometer in hand, braving the shock and calmly counting the regular pulsations of the subterranean thunder, which lasted six minutes. And this paucity of satisfactory observations is the more to be regretted from the fact that, as Leyell states, "in every instance where a spirit of scientific inquiry has animated the eye-witnesses of these events, facts calculated to throw light on former modifications of the earth's structure are recorded."

The South American earthquake waves seem to have extended over the whole zone already indicated, though with varying degrees of violence, varying, as we may conjecture, according to the physical constitution of the crust. So far as information has come to hand, the shocks appear to have been confined to the region between the Andes and the Pacific, and not to have swept to the eastward of the great mountain range; but the pulsations were conveyed along the bed of the ocean, (for it seems that earthquake waves are propagated from place to place precisely in the same manner and according to the same mechanical laws as a wave along the sea or the waves of sound along the air), and made themselves felt at far distant points. This is an observed and well known peculiarity of great earthquake shocks. "It has been computed," says Humboldt, "that during the earthquake of Lisbon on November 1st, 1755, a portion of the earth's surface four times greater than the extent of Europe was simultaneously shaken. The shock was felt in the Alps and on the coast of Sweden, in small inland lakes on the shores of the Baltic, in Thuringia, and in the flat country north of Germany. The thermal springs of Toplitz dried up and again returned, inundating everything with water discolored by ochre. In the islands of Antigua, Barbados, and Martinoy, in the West Indies, where the tide usually rises little more than two feet, it suddenly rose above twenty feet, the water being discolored and of an inky blackness. The movement was also sensible in the great lakes of Canada and on

the coast of Massachusetts." In like manner, the undulations of the same shock which last month convulsed the coast of Peru, manifested themselves in extraordinary tidal phenomena along the shores of California, 4,000 miles distant, and in the waters that wash the far-away Sandwich islands. These are facts of the profoundest scientific interest, but it would be hazardous at present to attempt deductions from data yet imperfect.

Perhaps there might be a field for inquiry opened up in reference to possible methods of mitigating the horribly destructive effects of earthquake shocks, especially in great cities which, when overtaken by energetic convulsions, are apt to be whelmed in ruin. It is among the functions of science (which seeks out the secrets of nature and causes them to minister to man) to turn aside, or at least to ameliorate those ills which are incidental to the working of the machinery of our habitable globe. Babinet notices that in general, Gothic constructions stand earthquakes better than do Greek edifices. It has also been observed in South America that fragile wooden houses with straw roofs resist by their very weakness shocks which topple down massive stone structures. As an illustration of the quick wittedness of we North Americans, it may be mentioned that, in the violent earthquake shock which happened at New Madrid, in 1812, the people, though wholly inexperienced in such perturbations, remarked that the chasms in the earth were in a direction from southwest to northeast, and they accordingly felled the tallest trees, and laying them at right angles to the chasms, stationed themselves upon them. "By this invention," says a geologist, "when chasms opened more than once under these trees, several persons were prevented from being swallowed up." One can hardly doubt that if Providence had afflicted with earthquakes the land of the Yankees, they would have found out a way to curb their disastrous effects. It is possible that iron architecture, affording as it does means for securing the most intimate cohesion between the roof and sides of a building, and enabling us to raise structures that will topple a great deal without divulsion, may yet be the solution of the problem; but this is merely a suggestion for the consideration of experts.

There is a reflection which is likely to suggest itself to one who dwells on these strange perturbations of nature, and that is as to the moral effect on the inhabitants of countries a prey to earthquakes and volcanos. This subject belongs to an obscure department of investigation which we might call the metaphysical effect of physical

agents, and on which Mr. Buckle has given some vivid elucidations, though he has not touched on this specific point. It is hardly necessary to remark that the accumulation of wealth (and consequently the progress of civilization which is dependent thereon), cannot but be retarded by convulsions that, like these late ones, overwhelm cities, destroy harbors, obliterate mines, etc. But, in addition, the sense of insecurity of property which comes over men in countries liable to frequent visitations of these scourges must relax industry, and unnerve ambition, and by creating a belief in the futility of human exertion, prepare the mind to fall a prey to demoralizing superstitions. It is thus that, in the lamentable accounts which come to us of the late earthquake, we have reports of how the image of a saint called "Senor del Mar" was carried to the sea in the belief that it would prevent the inundations, and of flocks of people following a *padre* down to the ocean to see him command the waves to retire, and then being overwhelmed themselves by the flood.

It is a different lesson altogether that science teaches. Why the working of the mechanism of our planets is attended with so much evil is a mystery beyond philosophy; but we do know that these tremendous convulsions are a part, and in the large sense even a beneficent part, of the general scheme, that, in the fine language of Lyell, "the earthquake itself, although so often the source of death and terror to the inhabitants of the globe, visiting in succession every zone, and filling the earth with monuments of ruin and disorder, is nevertheless the agent of a conservative principle above all others essential to the stability of the system."

These actions and reactions incessantly proceed. They have made the world what it is. Modern geology has banished the old notion of sudden cataclysms; of a time when nature

> "Wanton'd in her prime and played at will
> Her virgin fancies."

For the causes now at work are adequate to account for all cosmic changes, and the earthquake is an illustration of agencies which have given the form to our globe, which now continue to modify it, and which, in the future, are certain to subject its huge rondure to new transformations in the cycles of unending change.

A very animated debate followed the reading of Mr. Swinton's paper, and several other causes of earthquakes were suggested beside those mentioned by Mr. Swinton, namely: The gradually cooling and consequent contraction of the earth's crust; the pressure of steam

generated by water percolating into the heated interior; the generation of other gases by chemical action and electrical action. Whatever the cause, it was contended by several, that it must be similar to that which produced volcanic eruptions.

Mr. J. K. Fisher suggested that countries where earthquakes most prevail should have buildings constructed of iron.

Mr. Dudley Blanchard stated that quite a number of iron buildings had been constructed in this city, for South America, and were made strong for the purpose of resisting earthquakes.

Professor P. Vanderweyde remarked that experience has proved that light buildings are better than heavy ones in case of an earthquake. A heavy building is top-heavy and will come down very easily. That iron buildings would be better than wooden ones is very doubtful. There are two kinds of earthquakes, the slow upheavals and the rapid upheavals. Slow upheavals are continually taking place on the coast of Norway, and at Lower California the land has risen one foot out of water, and at Jersey a descent has taken place. Also, in Europe, in Holland and Belgium. The cause of this is probably due to the deposit at the bottom of the ocean carrying down a larger amount of alluvium, and causing a strain on the bottom of the ocean, which is felt at weaker points, as at Jersey and other places, producing elevations. The slow upheavals prevail over a larger range of surface than the rapid. When we consider the earth's crust, which is very thin, and the interior to be very hot, and when we see how water penetrates mountain ranges, is it to be wondered at that water should exert a pressure which would be continually increasing until it showed itself at the weakest point of the crust, as has been illustrated in the recent South American earthquake. The lava is pressed out by the pressure of the steam. The most natural explanation is to be found in the penetration of water into the interior of the earth, and causing steam to form, which shows itself in volcanoes and earthquakes. All of these earthquakes and volcanoes are near water, and it has been proved that these sudden convulsions of the earth are more numerous and violent during a heavy rain.

It has been a question among philosophers whether the temperature increases as we go down into the earth. In some localities we have an increase of one degree Fahrenheit for every sixty feet. Now, does this increase hold good as we descend into coal mines. In England there is a regular increase in the mines there, but may not this be due to the laborers working there. But it has been proposed to try if this increase

holds in coal mines where the temperature is some eighty or ninety degrees. It has been thought that if the crust of the Himmaleh mountains was very thin, it would not sustain its immense weight. It has been suggested that the motion of the moon would lead us to infer that the greater mass of the earth is solid. The thickness of the earth is said to be at least one-sixth of the diameter, in order to make it agree with the motion of the moon. The theory has also been broached that the whole earth may be solid, but liquid in some places; where the crust is very thick we have large surfaces such as our New York system of rocks, and those in Pennsylvania, the thickness of which can be readily seen.

The water of the earth will be entirely gone before the earth becomes solidified. When we consider that the ocean contains all the burnt up hydrogen which existed on our globe, and that the oxygen left is in our atmosphere to sustain animal life. There was an excess of oxygen on our globe and the result is that there was more oxygen in our atmosphere, and there was just enough hydrogen to combine with the oxygen and leave enough oxygen to make animal life possible, so that life on the other planets is very uncertain.

Dr. J. F. Boynton remarked that rocks are often found with their edges polished, this was no doubt owing to their first being broken and then rubbed together, causing the edges to become smooth and polished. In 1856 he visited the Middletown quarries in Connecticut, and was there shown fissures in the rocks, and was told that the workmen were on a certain time down in the rocks, when a slip of some two inches of the rocks took place. This was said to be the third time this had occurred. Earthquakes are as much a thing of necessity as any thing else in nature, to produce a change on our globe. Pennsylvania has been made what it is, by earthquakes, which have taken place when the sun and moon were in a peculiar position, and acting on this portion of our globe.

After some further discussion of this subject the association adjourned.

September 24, 1868.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

New Gas Burner.

Mr. C. D. Brown exhibited his improvement in gas burners. The device consists of a thin sheet of brass, placed on the burner, which

passes through the flame and divides it, whereby it is claimed an increased quantity of oxygen is furnished to the flame. He stated that twenty-seven per cent of gas is saved by this improvement.

Mr. C. E. Emery remarked that this addition to the burner seemed to make the light unsteady. Some time ago a piece of perforated mica was placed in the flame of gas, and an increase of light of from two to three per cent was effected.

Dr. J. B. Rich said the way in which the most perfect combustion is attained, is by using an Argand burner, one and a half inches in diameter, with some ninety holes in it. He found that, when the air was admitted in a fine stream, the best effect was produced.

Mr. C. E. Emery stated that, causing the air introduced into the furnace of a steam boiler to vibrate, made it evolve more heat, although there is no more air admitted at the time.

Dr. L. Feuchtwanger exhibited specimens of the sulphuret of mercury, from a new mine just opened at Nappa county, California.

Hoosic Tunnel.

Dr. D. D. Parmelee gave the following description of nitro-glycerine in relation to the Hoosic Tunnel:

When completed, the Hoosic tunnel will be about five miles in a direct line through and nearly at the base of the mountain. The highest point of earth above the grade of the road passing through it will be 1,768 feet.

The work is divided into two sections, one commencing at the east side of the mountain, and the other at the west side. At the present time a little more than a mile is completed of the east end, and very nearly a mile of the west end; about three miles are, therefore, yet to be drilled, blasted, and carried out at the ends of the tunnel, to join the two sections, and complete the work. This, it is estimated, will require not more than five years, nor less than three, according to the nature and stratification of the rocks. At the east end the workmen all pass in and out at the main entrance, as there are no shafts.

The drilling is accomplished by compressed air engines brought in through tubes leading from air pumps, which are worked by water power obtained by damming the Deerfield river. The work is progressing somewhat faster here than at the west end, as the rock is not so hard, and much more easily removed. The west section presents more subjects of interest than the east end. It is two miles from North Adams, Mass. The entrance commences in earth, the sides

and arch are of brick which are manufactured close by from clay a few rods distant.

About 1,000 feet from the main entrance within the tunnel drilling and blasting with powder is now going on day and night; and here, when the hammering ceases for a moment, the thumping of the drills, 275 feet, through rock, of the workmen engaged in the section further in the mountain, entered by shafts, may be distinctly heard. Returning to the entrance and up the mountain well No. 4 is reached; this is a shaft 211 feet deep. The drillers whose hammers are heard through the rock are 200 feet from the bottom of this shaft toward the main entrance. The drilling is here performed in the ordinary manner by man power, and the blasting is by powder. Ascending further up the mountain we next come to "supplementary shaft" which is 280 feet deep, and the bottom of which is 900 feet from well No. 4, measuring on the grade of the bottom of the tunnel. Walking further up the mountain we arrive at what is called "west shaft." This is 318 feet deep, and the bottom is 300 feet from supplementary shaft. Here are the elevators by which the men and all things employed below descend and ascend. Here too are the machine works, steam engines, air pumps, store houses, etc.

To descend the shaft you put on rubber boots with high tops, an oil cloth wrapper, and water proof hat, to keep out the water dripping down the side of the shaft and to be able to wade the water on the bottom of the tunnel below. From the bottom of this shaft you walk 1,500 feet east and come to the drillers who are managing two engines, mounted on heavy frames, and worked by compressed air. These have three drills each.

The compressed air is forced through large pipes coupled together, leading from the air pumps down the shaft, and thence along to the engines, section after section being added as the work progresses. The rock here is very hard and composed chiefly of quartz, considerable portions of which are translucent. Considerable water trickles through the crevices in the sides of the tunnel, and at one place a fountain of cold water jets with much force. This is said to be excellent drinking water. The water is now lifted by steam power at well No. 4. The quantity is 1,000 gallons each minute. When the 275 feet of rock, now forming a partition between the two sections, are removed, this pumping will not be required, for the water will then flow off at the main entrance.

For compressing air to work the drilling engines, there are four

pumps, each having a cylinder thirteen inches in diameter and twenty-four inches in length, internal measurement. The number of strokes each a minute are eighty. The cylinders and air are cooled by an ingenious mode of injecting cold water into them.

The occasion of my entering the tunnel was for the purpose of observing the mode adopted there for blasting by nitro-glycerine, which performance takes place every eight hours, night and day. I therefore accompanied Mr. Charles A. Brown, who has charge of everything pertaining to this department, down the shaft. On the platform at our feet, as we descended, was a basket containing a number of tin tubes, with corks in each, holding, altogether, twenty pounds of nitro-glycerine. This basket, I must confess, occupied, chiefly, my thoughts during the descent, notwithstanding Mr. Brown told a humorous anecdote; and a complication of pipes, braces and bolts formed the sides of the shaft in a manner naturally exciting attention and inquiry.

These were visible from the light of our tallow candles, adjusted in the fronts of our hats.

On arriving at the bottom of the shaft, Mr. Brown took the lead toward the drillers, 1,500 feet distant, with the basket of nitro-glycerine. When we came to the terminus, the machines were soon stopped. Mr. Brown measured each hole drilled, and made his memoranda of the depth.

The two engines were rolled back, over the iron rails laid for this purpose, several hundred feet, and a heavy shield of plank, spiked and bolted together, placed in front of them for the purpose of protecting them, and also the electrician. While this was going on, Mr. Brown was taking the tubes of nitro-glycerine from his basket, one at a time, withdrawing the cork, and inserting another, in which a fuse, made after the plan of Mr. Ables, was adjusted so as to immerse it in the explosive liquid. Attached to these fuse are two copper wires a few feet long, insulated with gutta percha. The tubes are next inserted in the holes, and pushed with a wood cane to the bottom, the insulated wires projecting a few inches out of the hole. Coarse, damp sand was next crowded down, and somewhat packed, until the holes were full.

The two wires of all the fuses were alternately connected to one of the two large insulated wires, which are attached to the sides of the tunnel, and extend about 600 feet from where the blast takes place. The wire at the left was also attached to the other prime wire. All

that was now needed was the electric spark to pass through the wires to explode all the cans simultaneously.

We then passed down the tunnel, leaving the infernal apparatus in darkness, to the ends of the prime wires a few feet behind the machines and shields just referred to. Here Mr. Brown connected the two wires to a small static electrical machine, made of vulcanite, and containing within one of its chambers a condenser. After about six turns of the crank of the machine, the accumulated electricity was discharged, and the seventeen pounds of nitro-glycerine exploded at once. At this moment the workmen had receded to beyond the shaft, and Mr. Brown had sent an assistant still farther off with the remaining three pounds of nitro-glycerine in the basket.

The shock of the explosion was felt instantaneously with the discharge of the electric current. The deep report was more like what I would imagine would be the effect of the loudest "thunder clap" confined in a like subterranean alley, than any effect I can think of to compare it with.

I was told that the force of air issuing from the top of the shaft is sufficient, on these occasions, to lift the hats of those near it, and that the vibrations are distinctly felt at the surface, through the nearly 600 feet of rock and earth above the blast.

The use of nitro-glycerine is hastening the work forward. One of the foremen of the shaft informed me that with this, one hole accomplished the removal of as much rock as three holes charged with powder, and in "stopping out bench work," one hole with nitro-glycerine is equal to eight charged with powder, in execution of work.

The nitro-glycerine is made at the laboratory constructed for the purpose near the shaft, under the direction of Mr. George M. Mowbray, who has recently made some valuable improvements in its manufacture.

They frequently make here 150 pounds daily.

On entering the converting department of these works the first that attracts the attention is a long trough, resembling a manger for feeding horses, about three feet above the floor, and fifty feet in whole extension, filled with ice and a little salt.

In this, about two feet apart, are earthen jars holding a gallon each, their tops projecting two or three inches above the ice. In these jars is the nitric and sulphuric acids. Immediately over the jars, two feet above, resting in a wood rack, are inverted cans, holding about one quart of glycerine. This drops into the acid

below, where the reaction takes place, and nitro-glycerine is formed, which falls to the bottom of the jar. Mr. Mowbray agitates his acids with cold air. For this purpose he leads the cold air resulting from the partial expansion of compressed air into the laboratory through iron pipes, and over each jar of acid is a cock to which a rubber tube is attached. On the end of this is a glass tube. During the reaction in the jars, and while dense volumes of nitrous-acid are evolved, and the heat which it is necessary to constantly keep down is rising, his men stir the mixture with these glass tubes, admitting a current of cold air which agitates, cools, and in escaping carries off the gas it is so essential to get rid of, as soon as possible after it is formed.

The next part of the process is the removal of these jars, and to empty their contents through a trap or square opening in the center of the floor, into a reservoir holding about forty gallons of water, for the purpose of washing off all traces of acid. This reservoir is of wood, lined with lead.

After washing the nitro-glycerine, the reservoir, which is balanced on two journals, is turned over on its side gradually and the nitro-glycerine emptied into glass and earthen receptacles. These are removed to the magazine, a few rods distant.

At the time I entered this magazine, there were 1,000 pounds of nitro-glycerine there in jars, holding from three to five gallons each, resting on benches.

Mr. Mowbray prepares his own nitric acid, near by, and also concentrates the sulphuric acid he employs. It is probably by close attention to the qualities of the materials he employs, and the thorough agitation and carrying off of the nitrous acid gas, by the cold air introduced into the jars for this purpose, and also to prevent elevation of temperature, that he succeeds in obtaining the quantity and quality of nitro-glycerine he does. Forty-two pounds of glycerine yields him ninety-four pounds of nitro-glycerine, which, at a temperature of forty-eight degrees and upward, is perfectly transparent and without color. A little below this temperature it becomes frozen, and then resembles pounded ice.

The men who are obliged to breathe the smoke resulting from the explosion of the nitro-glycerine in the tunnel, informed me that they experienced very little inconvenience from it, while formerly, when they used the imported article, and which was, more or less, yellow and brown, they were affected with intense headache.

One physical difference, which will be appreciated by chemists,

between that imported and Mr. Mowbray's make, is, that a twelve inch column of fluid nitro-glycerine, imported, will expand in freezing three-fourths of an inch in height, while that of Mr. Mowbray's shrinks half an inch. This is supposed to occur from the presence of nitrous gas in the one and an absence of it in the other.

Mr. Mowbray and the electrician, Mr. Brown, informed me that they had made experiments with frozen nitro-glycerine ; among which a tin tube was nearly filled with the liquid, then frozen. Gun-cotton in one case was placed over it ; in another, fulminate ; in another, gun powder. To these were attached electric fuses, the tubes placed between heavy blocks of ice, and fired. The result was to drive the frozen nitro-glycerine out of the tube into the ice, in the form of a candle ; no explosion of the nitro-glycerine taking place.

Mr. Mowbray, from this and other experiments, concludes that this agent may be transported quite safely in the frozen state.

There are two routes from New York to the Hoosic Tunnel. One, by the New Haven railroad to Bridgeport, thence by the Housatonic railroad to Pittsfield, Mass., then the Pittsfield and North Adams railroad; the other and quicker is the Hudson river railroad to Troy, thence by the Troy and North Adams railroad.

Dr. J. F. Boynton remarked that he had seen nitro-glycerine exploded on an anvil in Washington, by being struck with a smooth-faced hammer, and only that part which came in contact with the face of the hammer exploded.

Dr. D. D. Parmelee stated that nitro-glycerine will burn like oil, and not explode. But the least dirt, such as straw, or any other foreign substance causes immediate decomposition. In the room where the nitro-glycerine is made, potash is used to neutralize its explosive qualities, and such places where it may have dropped on the floor are covered with the potash.

The chairman presented the following interesting scientific items :

Coating for Cast Iron.

To protect cast iron work from oxydation or rust, W. Leike of Hanover has successfully used a mixture consisting of two parts of water-glass (silicate of soda) in solution, of the strength indicated by twenty degrees Baume, and one part of zinc oxyd. The material, laid on as a thick varnish, gives the iron an enameled appearance, and is not injured by the application of soap and water or other alkaline liquids.

Piers in Sea Water.

The timber piles forming the foundation of the railway bridge at Providence, R. I., having been almost eaten through above the sea bottom by worms, Mr. Cushing, the resident railway engineer, caused wooden piles to be driven, in groups, down through forty feet of mud to the hard pan, and inclosed the top of each group with a cast iron cylinder, which extends downward a little below the sea bottom, so as to prevent any contact of wood and water, thus effectually excluding the teredo, and forming a foundation of the most permanent character.

New Fluorescent Solution.

M. Ditte, of Paris, has obtained from Cuba wood (Morus tinctoria), a solution possessing remarkable fluorescent properties. His process in preparing the solution is to dissolve the cake in an excess of acetic acid which is accomplished in the course of twenty-four hours. Six times its volume of alcohol is then added and the mass filtered. The resulting liquid is red by transmitted light, and by reflected light a magnificent green. If pure ether is added to the acetic acid solution, a yellow matter is precipitated, and the liquid loses its dichroic property, while the precipitate dissolved in alcohol retains it. A decoction of Cuba wood is not dichroic, but becomes so by the addition of acetate of alumina. The fluorescence is very vivid with the magnesium light and in Geissler tubes, but is not visible in the light from a lamp, candle, or gas burner.

The Abyssinian Jibara.

A recent number of *The Journal of Travel* contains an illustration of this singular plant, which has no branches, and puts forth leaves only around the middle of the trunk, the upper portion being entirely bare. *The Journal* says: "There are a number of forms peculiar to Abyssinia itself, the most remarkable of which, perhaps, is the wonderful Jibara (*Rhyncho-petalum montanum*), the zone of which begins at 11,000 feet, and continues, so far as the soil extends, up to the highest tops, at first mixed with Erica aud Hypericum, then standing in thousands on the short grass of the meadows, blooming among numerous small alpine plants. It has long been known as one of the most striking plants of the country. Jussieu and most botanists have ranked it among Lobeliaceæ, but we think Robert Brown formed a truer estimate of its affinities when he placed it in the neighboring

order, the Campanulaceæ. If it were blue (which it is not), it might be called the blue-bell of Abyssinia, rather a different looking Campanula from our humble little hare-bell. It is a tree fifteen feet high, with succulent leaves, and, in some respects, bearing a great similarity to the Agaves, with which it has the additional point of resemblance that it lives until it flowers, and then dies. The flower-spike is yellowish red in color, and very handsome. Its other qualities, however, are not so pleasant; its fresh juice has the smell of bugs. It is very poisonous; so much so that even its shadow is said to be fatal to those who sleep under it. A more credible report is, that even its smoke occasions vomiting.

CATTLEYA DOWIANA.

The Country Gentleman's Magazine of London, gives the figure of this magnificent Orchid, which was received from Costa Rica through G. U. Skinner, Esq. In its coloring and general effect it is entirely unlike anything yet seen in the genus; the sepals and petals being of a mellow straw-color, while the lip is one uniform mass of the darkest purple velvet, streaked regularly throughout with gold threads. The expanded flowers are nearly seven inches across, and the fringed labellum is not less than four inches long, the latter having protruded about an inch beyond the point of the unexpanded buds. Its beauty entitles it to rank as queen of all known Cattleyas.

WHITE LEAD.

A new process for the manufacture of hydrated carbonate of lead has been invented by M. A. Girard, of France. Lead is first thoroughly granulated; the metal is then placed in a rotating cask, which should be made of beech or elm (not of oak) with one-fourth its weight of pure water. The cask is made to rotate thirty or forty turns a minute, and a current of air is forced in during the rotation. After about two hours nearly all the lead is found to be oxydized; then a current of carbonic acid is forced in instead of the air, and the rotation is continued for four or five hours longer, when the oxyd is found to be converted into the hydrated carbonate which is separated from the metal not oxydized by decantation. The new process differs somewhat from one often used in which litharge (oxyd of lead) is mixed with water and one per cent of neutral acetate of lead, over which carbonic acid gas is passed until the whole is converted into white lead. In this case the acetate of lead is first formed and then

decomposed by carbonic acid; the resulting acetic acid immediately acts on another portion of the oxyd and is again set free; thus a small portion of acetic acid is used over and over as the medium for dissolving the oxyd. The white lead made by this, as well as by the old Dutch process, contains an excess of hydrated oxyd of lead.

Sodium Salts Formed Synthetically.

Mr. A. R. Cotton gave, before the British Association for the Advancement of Science, the results of his experiments by which he succeeded in obtaining from 100 grammes of sodium 175 grammes of sodium salts of acids. His conclusions were: 1. That where a current of dry carbonic acid is kept constantly passing through absolute alcohol, which is in contact with sodium amalgam containing about two per cent of sodium, for every 150 grammes of sodium used in the reaction, at least 175 grammes of sodium salts, formed synthetically, are produced; about thirty-five grammes of which are sodium salts of volatile acids, and the remaining 140 grammes are the sodium salts of fixed acids. 2. That the volatile acids do not consist entirely of formic acid, but contain at least one acid of higher molecular weight. 3. That the fixed acids are principally acids having a greater atomicity than basicity, and they were originally produced as sodium salts, in which both the basic and typical hydrogen of the acid are replaced by sodium. At the conclusion of the paper, Prof. Frankland said Mr. Cotton, in this preliminary report, had shown conclusively that he had obtained a great quantity of the crude synthetical product, and the great problem now remained of isolating and determining the precise nature of the substances of which it is composed. Should he succeed in solving this problem, the result would be one of the most interesting discoveries in synthetical chemistry. Mr. Cotton had, no doubt, struck out a novel line of research in a class of investigations which at the present time prominently occupied the attention of chemists.

Buffers for Ship Cables.

Mr. R. Saunders lately described before the London Institution of Naval Architects his mode of applying portable buffers or springs to the cables of ships riding at anchor. In principle it is the same as that now applied to railway cars to control the sudden stopping and starting of trains. Mr. Saunders uses India rubber springs of great strength and power, say from twenty to eighty tons, suited to all

vessels from 200 to 3,000 tons. A clutch at one end of the spring has a spare chain passed through it, and that chain is either made fast to the bits or the windlass, clear of the chain cable which the ship is riding by. In case more cable is required the spare piece of chain is let go, when the ship will ride by a cable; the clutch is taken off in a moment, and the cable veered away as much as required. So long as ships ride in easy tides and in moderate weather the ordinary strength of a cable as guaranteed by proof test is amply sufficient; but when a ship is riding in a strong tideway and boiling eddies, or in a heavy sea and hard gales, the case is entirely different. At one moment she forges ahead toward her anchors; at another she sheers off at an angle of twenty-five degrees, or more, from the course of the tide; again she falls astern, and is suddenly checked. It is at this particular crisis that the anchor either starts from its holding bed or is broken; the chain snaps, the windlass is upset, or other serious damage transpires. To mitigate this damaging shock in storms the spring is applied. According to a well-known maxim, the strength of a chain is the strength of its weakest link; no more; and one flaw is fatal. But if at the moment of severest tension a few inches of stretch can be given by means of a powerful spring the danger of parting is thereby avoided. Many familiar examples might be given to illustrate this well-known law of dynamics. One that will readily occur to all seamen is the common use of fenders, particularly those made of coir and cork combined; how in a moment an otherwise severe concussion is rendered harmless by throwing such a squeezable cushion between the ship's side and the dockhead, or other rigid body coming in contact. The explanation is obvious. In the one case the shock is instantaneous, and, therefore, mischievous; in the other the momentum expends itself upon a yielding body, and no damage is done. Precisely on the same principle it is that the use of a spring, sufficiently powerful to act at the moment required, gives relief to a chain by absorbing the surplus strain. Statistics would amply show that where one ship is lost in mid-ocean, at least 100 are lost on various shores. Certificates were read by Mr. Saunders touching the actual use of these cable springs. The statements contained in one of these is sufficiently convincing. H. M. lightship Comet, in Gaspar channel had, previous to applying the spring, parted her cable on an average five times a year. In November last she rode through a cyclone, while two ships, a brig, and two powerful steamers, on better anchorage, within a few miles, each having two anchors down, all parted

their cables, and three of them were driven on shore. Aside from the question of safety, the comfort and rest of passengers is secured while the ship is riding at anchor during rough weather.

Distillation of Petroleum.

Dr. Joseph Hirsh, of Chicago, in a communication to *The London Chemical News*, gives the following rules, which, by experience, are found to regulate the distillation of a mixture of native hydrocarbons on an extensive scale: 1. The difference of temperature between the actual boiling point of oil of definite gravity and of the temperature to which it is raised, is proportionate to the effect of the process of "cracking;" *i. e.*, the more the temperature of the actual boiling point of oil of definite gravity is above the temperature to which the same oil is raised, the greater is the quantity of light oil obtained. If, then, we wish to reduce the gravity of a heavy oil greatly, we should have to employ an exceedingly low temperature, so low, sometimes, as to suspend actual distillation for a short time. 2. The gravity of the distillate, resulting from the reduction of temperature, will be directly proportionate to the said reduction; *i. e.*, if we reduce the temperature to a degree at which naphtha of 0.700 boils, the resulting distillate will possess a specific gravity of 0.700, regardless of the gravity of the original oil. This law enables us to produce a distillate of any desired gravity (below that of the oil before distillation) from any crude oil, and a due regard to it enables us to produce illuminating oil, without great quantitative loss, from the light Pennsylvania oils, of the same specific gravity as that produced from the heavier Ohio, Canada or California oils. In distillation, the temperature, therefore, should always be reduced to the boiling point of oil of the specific gravity desired. 3. The difference between the temperature of the two boiling points, viz., of the oil being subjected to distillation, and of the desired distillate, is in direct proportion to the height of the still employed, or, which produces the same effect, to the facility for cooling the upper portions of the still. According to this law, a heavy oil will yield the readier a light distillate, the higher the vapors have to rise before leaving the still, because the reduction of temperature in those higher portions of a retort, which are more remote from the source of heat, acts upon the vapor of the oil in fine division, and reduces their gravity more readily than the compact liquid oil. If the heat is applied solely to the bottom of the still, while its sides and top may be exposed to a current of cool air, the reduction of the tem-

perature of the oil vapors takes place similarly to, and can be controlled better than, the cooling in high stills, without this provision. The arrangements for cooling the sides and top of a still must therefore be more complete the lower or smaller the still employed is. This law also teaches us that stills, to be used for "cracking" oil, should have a flat bottom, and should have the flues arranged in such a manner as to permit the restriction of the fire to the bottom only, which is necessary in the process of "cracking." Where superheated steam is used as the heating medium it ought to be applied to the bottom only. Where the dimension of stills become huge, as those, for instance, in the refinery of Reese & Graff, Pittsburg, Pennsylvania, which have a capacity of 40,000 gallons each, a flat bottom would hardly be strong enough; in such cases the boiler shape is usually employed. In order to have a practically sufficiently large heating surface, the fire has to reach up to a certain distance on the round boiler. If the quantity of oil present in the still is so small as to be below the boiler surface exposed to the fire, the rising oil vapors will be superheated on this surface, and the resulting distillate will be of greater specific gravity, and of darker color than it normally would have been, the product resembling more the oils resulting from the distillation of coal-tar. For this reason the residuum in such stills, after reduction to the quantity mentioned, is frequently removed to the smaller stills; this diminution of the temperature of the oil vapors causes a partial condensation and redistillation of the oil, which diminishes its color and gravity. 4. The intensity of the process of "cracking" is proportionate to the suddenness with which the oil vapors are condensed before leaving the still. The thorough application of this principle produces more rapidly those results mentioned as necessary in the preceding paragraph. 5. The difference in gravity between that of the oil distilled, and of the desired distillate, is in direct proportion to the quantity of water produced in the process. If from a heavy oil, an exceedingly light distillate is to be produced, the proportion of water is so immense as to show occasionally a distillate of water with but a minute percentage of oil floating on its surface. In all such cases small black particles of carbon float on the top of the water, forming an intermediate layer between the latter and the oil. The quantity of carbon separated in this manner is also proportionate to the quantity of water distilled over respectively and the intensity of the process of "cracking" employed. This carbon is mechanically carried over by particles of water which, in con-

tact with oil, always produce violent ebullition. These laws are the same with hydrocarbons distilled under the ordinary atmospheric pressure, as with those distilled in a vacuum or under increased pressure. In the last two cases the variation of the boiling point corresponding to these different degrees of temperature has been taken into consideration.

After a discussion of points suggested by the foregoing articles, the association adjourned.

October 1, 1868.

Prof. S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

New Water Meter.

Mr. Groesbar exhibited his new water meter, the piston and valve being made in one piece. There are two rollers of round India rubber which roll over the piston.

Mr. Emery said he was present at the last trial of meters, and it was quite interesting to see the variety of machines constructed to measure water. He believed that a good meter was a mere question of mechanical skill. The piston meters will undoubtedly be the best ones. The screw meter was not a success. The only patents that can now be obtained for water meters are for the valves.

Mr. Stetson remarked that there are so many different conditions required in a meter, that one to answer all purposes is very difficult. In some places a meter is wanted to measure water very accurately, and at other places exactness is not so much cared for. At Boston they are so situated that they can afford water very cheap, but in Brooklyn it is expensive, and hence it will pay to have a cheap meter.

Dr. Vanderweyde thought the screw meter almost worthless where accuracy is required. The one here exhibited appears to be a very ingenious one, and deserves more than a passing notice.

New Method for Remembering Historical Events.

Mr. Napoleon Zaba explained his method of studying history. The system of Mr. Zaba is mnemonic, and is taught by means of a series of diagrams, which should be here presented in order to make the subject understood. The speaker occupied a half an hour, and succeeded in convincing some of his audience that this plan for retaining history was feasible.

ROCKING CHAIR SPRINGS.

Mr. I. Blake exhibited his patent spring rocking chair. The principal feature of this invention was the use of a spiral, tapered spring, so constructed as to be readily attached to the hind legs of a common chair, which can thus be immediately used as a rocking chair. The price of the springs was one dollar a pair. The chair was thought to be convenient for very uneasy people, who were not contented to remain in the same position more than a minute.

The following interesting paper was then read by its author:

THE RELATIONS OF MANUFACTURERS TO INVENTORS AND MIDDLEMEN.

Mr. Thomas D. Stetson.—In all branches of manufacture, inventing forms, directly or indirectly, an important element. A patent, in this country, endures seventeen years, during which time very great changes are liable to occur; partly caprice, but mainly improvements. During the last decade, clocks have changed but little, window-glass less, boots and shoes a little more, but the means of producing the last have been almost entirely revolutionized. The hat manufacture is one which is, at this moment, being changed from hand-work to machinery at a rate which is hardly appreciated, even by those who are in the strongest part of the current. In all branches of manufacture there is, or is likely to be, progress.

The manufacturing concern which refuses to introduce any improvements, will sink out of sight. The concern, which buys all at the price asked, and pays the license fees without esteeming such questions worthy of study, will contribute, and rightly, to the income of some other party, who has invested with more knowledge and foresight, and earlier assisted, to bring forward the improvement. And the concern, which undertakes to bid defiance to the patent laws, and adopt improvements at will, without paying any one, will live an unchristian and unprofitable life, and perish unlamented, except by lawyers.

There are three requisites, to genuine success, to an inventor with moderate means. First, or at some stage, the procuring of a patent. Second, or first, or simultaneously, with the patent, the carrying out of the invention. And, third, the convincing of others of its value and arranging for its use. This last step is usually the most difficult. At any rate, it calls for a different order of talent from the others. As a general rule, the three steps require three different operators.

There are inventors, who are excellent business men, capable of

undertaking almost any branch of business. Of such, Mr. Corliss, of "the Corliss Steam Engine Company;" Mr. Hotchkiss, of Rifle Cannon Projectiles; Col. Hoe, and a few others, are examples; but, usually, the inventor is not the best man to take either of the three steps.

It may seem a bold proposition to say that the inventor is not the best man to work out and experiment on his own invention; in other words, to reduce it to practice; but, as a general proposition, it is true.

The capital and skill possessed by established manufacturers, are essential to the success of new inventions. Inventors over-rate the value of their novel ideas when they imagine that they will more than compensate for the absence of experience. An inventor, who takes a patent in an art with which he is not familiar, and undertakes alone to work it in competition with established manufacturers operating on the old plan, is in purgatory, if not a shade lower. Inventions must be worked with capital and skill.

A partnership between an inventor and a good business man is a desirable arrangement sometimes. But when the invention alone is wanted, it is generally inexpedient to make the inventor an active partner.

As a general fact, an inventor—a man, of whom nothing else is known than that he has made a valuable invention—will make a poor superintendent, or foreman, for the same reason, that, as a general fact, any individual selected at random, will make a poor superintendent or foreman. The possession of an inventive mind does not make a man more qualified to fill positions of trust. Desirable superintendents, foremen, presidents, treasurers, directors, general or special agents, buyers, salesmen, travelers; these are not ordinary productions. They are rare men. The value of their services is due to qualifications independent of invention which are rarely found, and they must often be selected without reference to the possession of the additional quality of invention.

When, however, it is possible to secure a man otherwise valuable, who has a talent for invention, and the still more rare talent of controlling it, so that it will not run away with him, secure him as a prize and make liberal arrangements with him. Pay him for his inventions either separately or by a good salary. Make it an object for him to come to you and stay with you. Occasionally it will pay to hire a man on purpose to invent.

In many instances, inventions, or an interest therein are sold by

the inventor for a moderate sum before an application for a patent has been made, or afterward before the issue of the patent. This is the cheapest time to buy an invention. With any, even very moderate, judgment in regard to the merits, the chances of success are greater than the prices asked at this period. In many instances half of a good patent is purchased for the payment of the expenses of making and conducting the application, about $100. The dearest time to buy the whole, or any part, is after a patent has issued, and after the inventor, or his representative, has great ideas of its value; but before any reliable tests of its merits can be produced. Here the chance of ultimate success is but little improved, while the price of the invention has increased perhaps one hundred fold. In many instances, when inventions are for sale under such conditions, they have been tested privately by the inventors, or their assigns, and found failures.

An invention may judiciously be purchased immature and untested, but this condition should be understood. Draw a strong black line between what has been done, and what some one thinks can be done. In this country, inventions are usually patented immature; in Great Britain and France, they are almost necessarily so. Skill, usually other than the inventor's, must be applied either before or after the issue of the patent. This must be often done in this country to overcome the difficulties interposed by the patent-office before a patent can be secured, and must be always done, in every country, to overcome the obstacles in forcing it into use, and to develop and test its true value.

Even very important, simple and economical inventions will not work their own way. The many excellent improvements buried among the rejected applications in the United States patent-office, silently, but eloquently, attest this fact. Nobody hears of them, because it is nobody's interest to drive them. Better inventions, in the woolen manufacture, were refused patents, between the years 1840 and 1860, than have been patented since. I do not mean that the later patents do not exhibit a more advanced progress, but that greater steps in advance were described then, and that the subsequent steps have been smaller, as a general rule. An inventor cannot usually conduct his own application for patent, cannot advertise his invention to an unappreciative community, and cannot reduce his invention alone to practical perfection. Different inventors err in different directions. In many cases, an honest inventor, from over enthusiasm, or other

cause, does not recognize success when he has developed it. The world waited thirty years after the locomotive had been built, while inventors experimented with cog-wheels and racks to prevent the driving-wheels from slipping.

The true relation of manufacturers to inventions obviously lies in mutually aiding each other; capital and skill on the one hand, and inventions on the other, must assist each other, and mutually pay each other. The slowness of manufacturers in appreciating the "situation" creates a necessity for middlemen, who perform a useful work, but usually at a very high price, and often with a disregard for common honesty, which does much to defeat the success of conscientious operators.

With some inventors, a license fee proportionate to the use made of the invention is most satisfactory, and develops the invention with the highest benefit to the parties and to the world; with others, and particularly with inventors, who are very bad business men, a complete transfer of the entire invention is almost unavoidable.

Giving an inventor an interest in the future working in some manner either by stock, license fee, or contingent payments, is so far preferable to clear cash payments in the infancy of an invention as to require no argument. It is a suspicious circumstance when an inventor insists on receiving cash for the whole amount accruing to him. On the other hand, it is in most cases reasonable that an inventor shall receive a fourth, or some other portion of his pay in cash, as an assurance that the associates, to whom he gives up the whole or a large part of his invention, are in earnest and will proceed to develop it in good faith.

The purchase of an undivided portion of a patent involves a kind of partnership with the inventor which may lead to difficulties in case of infringement. The purchase of a license may lead to fault finding in the same event. The purchase of an exclusive license is open to less objection, but usually a complete purchase of the entire patent is preferable.

In conclusion, gentlemen, manufacturers use inventions and give them attention, but not to the neglect of the regular manufacture. Keep the broad line always clear between experience and conjecture. If necessary, establish a separate department to make and test inventions. Pay the inventor, but buy wisely. Count the purchase of inventions, or rights in them, as legitimate an expense as the insurance on your buildings.

One of the principal incentives to the formation of a stock company to work a patent, is the certainty with which the patent can be managed. The majority of the stock dictates the policy. There may not be harmony among the owners, but there is pretty certain to be a unity in action. Where patents are owned in fractions by individuals, either owner, hanging back, can veto the action of the others, and the whole proceedings come to a dead lock. An owner of stock in a company cannot do this; he can only exercise his rights in electing the directors. If his party is defeated, his power is at an end until the next election. An incorporated company threatens or sues, compromises or surrenders, as its officers judge for the best interests of the whole, without any compelled deference to the wishes of the inventor or any other partial owner.

In the discussion which followed Mr. Stetson's paper, Dr. Parmelee remarked, that when the improvement in children's shoes, by having the toes copper-tipped, was first introduced, he thought very little of it, and a friend of his was offered one-quarter of the patent for $500; but after two years, that interest could not be had for $25,000.

The chairman presented his usual budget of scientific news, as follows:

Great Bridge over the Ohio River.

The iron railway bridge now in course of construction between Louisville, Ky., and Jeffersonville, Ind., will be just one mile in length. It will have twenty-four spans, two of these will be 370 feet each, and six, 245.5 feet each. Excepting on the longest spans, the rails will be placed on the tops of the girders, these being of the class known as the Fink truss. A description of the truss is here quoted from a paper on "American Iron Bridges," read by Mr. Colburn, before the London Institution of Civil Engineers. "In this bridge a pair of diagonal tension bars connect the foot of the principal strut or 'king-post' in each truss, with the ends of the top chord. This pair of diagonal bars supports one of the whole weight of the truss and its load. Each half span is subdivided by a strut; and two diagonal tension bars extend, one to the nearest end of the top chord, and the other to the top of the center post. Each quarter span is again subdivided into eighths, and these again, for spans greater than 100 feet, into sixteenths. In a truss of this kind, having sixteen panels, the weight of the bottom of the strut nearest to either of the piers is distributed as follows: Calling the weight one, one-half is trans-

ferred directly through a tension-rod to the nearest end of the top chord, and thus upon the pier. The other half is carried to the top of the second strut from the pier, and is received at the bottom of that strut by a pair of tension-rods, which subdivide this half between them; one-fourth being taken directly to the nearest pier, while the other fourth is transferred to the top of the strut at the quarter span. This fourth is again subdivided at the foot of this strut; one-eighth being transmitted through a tension-rod to the nearest pier, while the other eighth passes to the top of the middle strut of the whole span, and is received at the foot of this strut by the main tension-rods, which thus transmit one-sixteenth of the original load to each pier. Thus the weight at the foot of the first strut from the end of the truss, is distributed as follows: One-half, one-fourth, one-eighth, one-sixteenth, or, in all, fifteen-sixteenths of that weight reach the top of the nearest pier through four converging sets of tension-rods, while the remaining sixteenth reaches the opposite pier, after having been first brought to the foot of the center strut, through the intervention of three separate systems of tension-bars. With the exception of the load at the foot of the center strut, which load is transmitted directly to the piers, the loads at the bottom of the vertical struts are more or less subdivided in the manner just described, before reaching the ends of the truss." The estimated cost of this bridge, which is to be completed by September 1st, 1869, is $1,600,000. The chief engineer of the work is Mr. Alfred Fink, and the assistant engineer, Mr. F. W. Vaughan.

REFRACTION OF LIGHT.

Dr. Gladstone recently presented at the Royal Institution of London the results of some new researches relating to the refractive indices of different substances, showing how the index varies with temperature. By means of an electric lamp he threw the yellow line in the spectrum of the metal sodium on a screen, and used a hollow prism filled with the oil of nutmeg as the refracting medium. This oil was selected because its temperature is very readily changed, but any other oil will answer the purpose. The prism was fixed at its angle of minimum deviation, and the position of the yellow band of the spectrum was marked by a strip of black paper. On stirring the oil with heated metallic rods its temperature was increased, and the yellow sodium line was shown to be less refracted than before. He had tried a vast number of liquids, and hence concludes that all liquids have their index of refraction diminished by heat.

He had also turned his attention to solids, but on finding that the refractive index of crown glass was not changed by heat he discontinued his investigation; but Fizean, of France, had since discovered that in nearly all cases the refractive index of solids is increased by heat; the two exceptions noted by him being crown glass, which is not altered, and fluor spar, which has its refractive power diminished by heat.

Dr. Gladstone and the Rev. Pelham Dale, while experimenting together, had discovered one optical property which was constant under varying temperatures, and common to solid, liquid, and gaseous conditions, namely, the specific refractive energy; that is to say, the refractive index, minus one, divided by the density. The specific energy multiplied by the atomic weight of a body will give its refractive equivalent. Tables had been computed by the lecturer showing the atomic weights of various elementary substances and their corresponding refractive equivalents, which were then exhibited. Compound bodies generally possess the mean refracting power of their constituents. By experiment it was shown that on mixing spirits and water the resulting liquid gives a little more refraction than either of these substances before the mixture, owing to a slight contraction in bulk when spirits and water are mixed, the increased refraction being due entirely to increased density. The most general law arrived at from these researches, is that the refraction equivalent of any substance (whether a mixture or a true chemical compound) is the sum of the refractive equivalents of its constituents.

The substance of greatest dispersive power now known is melted phosphorus. Next to it stands oxychloride of vanadium, then follows sulphur. It might be asked why some substances, such as Iceland spar, are double refracting. Dr. Gladstone believed such substances have different degrees of tension in different directions. The atoms may be more free to move in one way than in another, so that, in one direction, they offer more resistance to the passage of light. Consequently, on dissolving such substances, the property of double refraction should disappear. Such, on experiment, is found to be the fact; the solutions of such crystals give only one image, which is about the mean of the two seen in the solid.

One of the most beautiful experiments made by Dr. Gladstone was the formation of ice flowers. A slab of ice cut parallel to the plane of freezing was placed in front of the electric light, and greatly magnified by means of a lens. As the ice began to melt, the flowers

began to appear, growing like stars on the screen. As they were enlarged, a circle or oval appeared in the middle of each star. These beautiful and symmetrical flowers become visible, because water refracts light differently from ice. But, as water between thirty-two degrees and thirty-nine degrees Fahrenheit is less dense, and consequently occupies less space than the ice from which it is made, a vacuum is formed in the middle of each star by virtue of the melting ice, which is the cause of the circular or oval appearances.

GERANOSINE.

This new dye is made by dissolving one kilogramme of any salt of roseanaline in 1,000 liters of boiling water; when this solution has cooled to 113 degrees Fahrenheit, it is mixed with another consisting of four and a half kilogrammes of binoxyd of barium with thirty-five liters of cold water and ten kilogrammes of sulphuric acid. The mixture instantly becomes a lemon color, but in a short time is nearly colorless. After being filtered, to separate the sulphate of baryta, the solution is gradually heated to the boiling point, when it assumes a red color, which reaches its greatest intensity after boiling for two minutes, and is then ready for use. The shade of color produced by this dye is known as *ponceau*, and is equal in brilliancy to that made by cochineal. The application of acid strengthens the color, and ammonia discharges it.

NAPHTHYL-CARMINE.

M. Vohl prepares this dye by first dissolving twelve parts of naphthaline in 109 parts of sulphuric acid, and adding, by degrees, eighty-nine per cent of bichromate of potash. After the reaction has terminated, boiling water is added, and carbonic acid is disengaged. Carbonate of soda is employed to neutralize the solution, which, after being boiled for a quarter of an hour, is filtered to separate the oxyd of chromium. The solution has now a beautiful golden color, but on adding hydrochloric or sulphuric acid an abundant precipitant is obtained, which is naphthyl-carmine. This product is an acid, giving, with alkalies, a yellow solution, which dyes silks and wool, with mordants, either orange or violet.

COFFEE USED IN PHOTOGRAPHY.

Mr. Ottavio Baratti, editor of *La Camera Obscura*, Ivre Piverone, Italy, has invented a coffee dry process, by which plates prepared

twenty-two months back gave excellent negatives after ten seconds of exposure. He uses, as a preserving liquid, water, 300 grams; ground coffee, thirty grams; refined sugar, fifteen grams. His developer consists of

	Grams.
Distilled water	300.
Double sulphate of ammonia and iron	7.50
Crystallized sugar	7.50
Sulphate of copper	7.50
Citric acid	15.

After the plates have been treated with the preserving solution, they are dried by means of a tin box filled with very hot sand, or by water kept at the boiling point by means of a spirit lamp. The dried plates are then placed in a box with chloride of calcium on the bottom; thus the collodonized surface takes the appearance of a very brilliant varnish.

THE CHLAMYDER.

M. Pouchet, director of the Rouen museum of natural history, in his new work thus describes the habits of this curious bird: "The speckled chlamyder is a bird resembling our partridge, but is distinguished by its deep color, relieved by clear spots, and by its neck, which is adorned with a red collar. For the location of their nest the couple choose an open spot, exposed to the sun. Their first care is to make a path of round pebbles; when they deem it sufficiently thick, they plant in it a little avenue of branches. They are seen, for this purpose, to bring from the country slender shoots of trees, of about the same size, which they thrust solidly by the thick end into the interstices of the stones. The branches are disposed in two parallel rows, converging a little in such a manner that they form a miniature shrubbery. The plantation is a yard in length, and is sufficiently wide to allow the two birds to walk along side of each other in the interior. This grove being finished, they devote themselves to embellishing. Each starts out foraging in the fields, and brings back all the sparkling objects it can pick up; pearl shells, birds' feathers, all that can charm the eye. These trophies are suspended at the entrance to the grove, which soon begins to shine in the sun like a palace of the Arabian Knights. In the places frequented by the chlamyders, if a traveler loses his watch, his knife, his seal, he does not spend his time looking for it on the ground; he knows where to find it."

Dynamite.

This name, derived from a Greek word meaning "power," is given to a new explosive compound introduced by Mr. Nobel, the engineer who first brought nitro-glycerine into practical use for blasting. The composition of the new substance was kept secret for some time, it is, however, now known to be simply nitro-glycerine mixed mechanically with some inert body. A deposit of infusorial earth near San Francisco, composed of silica and sold as a polishing powder, is the body mixed with nitro-glycerine to make dynamite for California miners, which meets with an extensive sale.

Sugar in Brewing.

The quantity of sugar used in the breweries of Great Britain during the year 1867 was 41,134,000 pounds. This is a vast increase over that used in any preceding year, and was doubtless owing to a deficiency in the quantity of malt made and imported. According to Dr. Ure an equal quantity of proof spirits (eighteen gallons) can be obtained from one quarter of malt weighing 336 pounds; from 175 pounds of the best West India sugar; from 234 pounds of inferior Jamaica sugar, and from 295 pounds of refined or sugar-house molasses. The manner of using sugar in brewing varies considerably in different breweries. A common practice is to dissolve it in boiling water and add to it the malt worts in the hop back. Some brewers place the sugar in the coolers; others in the fermenting tuns shortly before cleansing, and if it is thoroughly dissolved before being casked, quite enough fermentation will have ensued. When sugar is used in very small quantities it is sometimes put into the casks of beer after fermentation has ceased, but great care must be taken to put it in at the right time; and it must not be done if the beer is to be kept for any length of time, for the second fermentation thus set up is sure to be followed by a reaction of flatness, with great tendency to acetous fermentation. The quantity of malt imported into Great Britain in 1867 was less than that imported in 1866 by more than 2,750,000 hundred weight. Brewers, having discovered that they can make an acceptable beverage by substituting sugar or molasses for barley and adding pernicious narcotic adulterations, will probably never return to the old fashioned method of brewing, and British beer must hereafter be defined as a mixture of rum and malt liquor.

PROPAGATION OF SOUND IN TUBES.

M. Kundt has made a series of elaborate experiments to determine the velocity of sound in tubes. He finds that the velocity diminishes with the diameter of the tube, but this diminution only becomes sensible when the diameter is equal to one-fourth of the length of the air-waves producing a given sound. Starting with this diameter, he finds the velocity of sound diminishes with the increase of pitch, or, in other words, the velocity increases as the length of the air-waves increase. In tubes of small diameter he discovered that fine powder distributed over the interior, checked the progress of sound in direct proportion to the quantity and lightness of the powder; yet a roughness in the tube itself does not retard sound. The amplitude of the air-wave or the intensity of sound was found to produce no influence on the rate of propagation. In this connection we may allude to the experiments recently made by M. Regnault of the French Institute. He used the new sewers in the city of Paris for the purpose of determining the force of the air waves producing sound. By firing a pistol in tubes and sewers of various diameters, he found that the sound was carried, in a passage 4.2 inches in diameter, through a distance of 1,282 yards; in a passage 11.8 inches in diameter, 4,191 yards; in a passage forty-three inches in diameter, 10,494. The manner of constructing the tube, and the material of which it is composed, exercises a great influence on the rapidity with which sound is transmitted.

LIQUIFYING LAUGHING GAS.

The uniform efficiency and safety of laughing gas as an anesthetic has prompted *The British Medical Journal* to suggest that a bottle be made strong enough to hold the gas in a liquid form, and of such weight and dimensions that it may be easily carried by the surgeon in his daily rounds. At present it is used by dentists from large bags, into which it is placed as soon as made. Laughing gas is composed, according to the new notation, of two atoms of nitrogen and one of oxygen. These two elements are the principal constituents of common air. Laughing gas, or nitrous oxyd can be liquified under a pressure of 750 pounds per square inch, when at the temperature of forty-five degrees Fahrenheit. The most convenient and safe receptacle for the liquid would be a brass or copper tube, not more than a foot in length, and of such thickness as to resist a pressure of at least 1,500 pounds, or several small tubes of the ordinary thickness might be united side by side and made entirely safe.

Tea Float.

Messrs. Field, of Newcastle-upon-the-Tine, have devised and patented a method of making tea, which they claim effects a saving in the amount of the tea used. Boiling tea has a tendency to dissipate the active principle, theine, but exposing the leaves to the highest temperature below the boiling point extracts the theine rapidly, without making the beverage unpalatable. As the hottest portion of the water is always at the top of the vessel, the tea is placed in a cylindrical metallic sieve, which is made to float by means of an air chamber attached to it, so that the tea is always in the position to be influenced by the greatest heat.

Bottom-Cast Steel Ingots.

Mr. A. L. Holly, of the Pennsylvania Steel Works has introduced a new process in casting Bessemer steel ingots, which consists of making a nest of ingots in one piece by pouring the metal at the bottom and in the center of the mold. In this manner 5,000 ingots have been cast, mostly in groups of seven. Arrangements are now being made to cast the whole charge of five tons in a group of thirteen. The improved flasks consist of large cast iron bottoms, with a central cavity, in which the prolongation of the central or sprue mold is formed, and radical channels in which the runners from this sprue mold to the surrounding molds are formed. The cavity and runners are lined with molding material (old ground fire-brick and loam) from one-half to one inch in thickness. The patterns are all formed on the follow-board, and drawn at one operation. The advantages of Mr. Holley's process over the ordinary one of pouring into the top of the mold are:

1. The improved quality of the ingots. In the ordinary method the steel falls the whole length of the mold and spatters on the sides, consequently the ingot is more or less porous. By the new plan the steel rises gradually in the mold, and is pressed against the top by a ferro-static column, one foot or more in height. The ingot thus made is less porous, and has a smooth exterior.

2. A saving of scrap; for under the old system the ingots cannot be made of uniform length.

3. Convenience of working; the best proof of it being that the workmen prefer the new process.

4. The saving of the ingot molds. Many of the molds of the new model in the Pennsylvania Steel Works have been used 400

times, which is about four times the service obtained from a mold of the old form.

The Wilson Furnace.

The novelty in the furnace patented by Edward B. Wilson, of England, relates to the fuel chamber, which is constructed in such a manner that, when fresh fuel is supplied, as usual, on the top of the fuel already ignited, the gases generated therefrom are made to pass downward through the hot fuel, in lieu, as heretofore, of ascending through the fresh fuel, and air is also supplied at such points and in such quantity as will be suitable for combustion. The introduction of this furnace involved a series of battles with the puddlers, who opposed the innovation. It has, however, been in successful operation for some time at the Thornby Iron Works. The Dunham coal used at these works having the quality of coking, and being more bituminous than coal of other districts, the conditions of ignition were wholly dissimilar. The furnace was specially adapted to these conditions. By the action of a damper, only air enough was admitted to burn the gases properly, while a large generator provided a constant supply of gas. No other furnace would work with the damper in the same position, owing to the difference in the size of the fire-grate and damper. The returns of Thornby Iron Works show that fifteen tons of puddled bars were manufactured per week of fifty-nine heats at seventeen and a half hundred weight of rough small coals per ton. Mr. Thomas Whitman, in a paper on this furnace, read before the Cleveland Institution of Engineers, claimed for it these advantages: 1. It would make more puddled bars out of a given quantity of metal than any other furnace. 2. It would make a better quality than other furnaces, as it never burned the iron, and never worked "rash." 3. It would, under proper treatment, consume all its own smoke. 4. That it would not use more fettling than other furnaces; the cost of repairs could not be great, for, in the Wilson furnace, a less quantity of fuel being burned, there was less cutting action on the brickwork.

After some discussion of these items, the association adjourned.

October 8, 1868.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

New Elevator.

Mr. George R. Clarke's improved elevator for buildings was exhibited and explained. This elevator is designed to prevent loss of life or injury to the person in the event of the breaking of the draught or lifting rope. The elevator is furnished underneath its platform with a rotating screw-blade, which works between studs arranged in vertical series on the four corner posts of the well or passage in which the elevator moves; the screw-blade being turned or rotated as the elevator is raised or lowered and serving to hold it in a fixed position in case of the parting of the draught rope.

A gentleman present described a plan of working a safety elevator by means of double ropes, one of which sustained the weight of the elevator while the other ran slack over the pulleys, but was so adjusted that in case the sustaining rope should break, the elevator would be held by the other, after falling but a very slight distance. Another member set forth a plan tried in England, in which hydraulic pressure was employed in the operation of the elevator. The platform of the latter was furnished with a downwardly extending vertical tube which, through a suitable stuffing-box, passed into a larger tube fixed in a deep well formed in the ground, and into which the water was forced by suitable means to raise the elevator. This plan, although working with great smoothness and efficiency, was objectionable on account of its cost.

Mr. C. E. Emery remarked that the revolving screw which works by a rack, is also very safe, but has more friction than others. Then there is one having a common long screw with a short nut. Elevators that have springs to throw out prawls into notches are perhaps the safest. But in all elevating machines the power used to work them is too great.

Mr. T. D. Stetson said it was evident that the screw principle is much the safest of any now in use. The plan here shown is simply a railroad car running up an inclined plane.

Stump Extractor.

Another invention by Mr. George R. Clarke was also brought forward in the shape of an improved stump-puller, which consisted in a

triangular frame having two legs or posts firmly united at the top, and another pivoted thereto at the point of junction. The two posts just mentioned have provided thereon a system of gears and pulleys working to wind and unwind a suitable rope upon a drum, also carried upon such posts; these latter being, furthermore, furnished with two wheels in such a manner that when the frame is folded and brought to a horizontal position it may be readily run upon such wheels from place to place, while, when set upright, the frame will serve to sustain the mechanism just hereinbefore indicated, which winds the rope in the operation of the machine. One feature of the apparatus which called out approving remarks from several present was the facility with which the gearing may be adjusted to proportion the power to the speed, as circumstances may render expedient.

NEW SCREW CLAMP.

Dr. Rowell exhibited a screw clamp in which the screw works in a nut formed with two movable parts held in position by means of springs. When it is desired to move the screw with facility for any distance it is released from the nut by compressing the springs which hold the latter thereto.

RAILWAY BRIDGE OVER THE SUSQUEHANNA.

Mr. Stetson gave a verbal description of the piers of the bridge over the Susquehanna at Havre de Grace, and also the structure of the bridge itself; illustrating his remarks by means of diagrams on the blackboard.

METEORIC STONE.

Dr. L. Feuchtwanger exhibited some fragments of a meteoric stone which fell in Warsaw, Poland, in January last. The stones were round, he said, which showed that sometime elapsed in their falling. There were over a million pieces of this meteor, found spread over 2,000 acres. He was about analyzing one of them. There are eight masses weighing from 800 to 1,000 pounds. There was one stone of 5,000 pounds weight which fell previously in Mexico.

NEW TANNING MATERIAL.

Mr. Orville M. Tinkham exhibited specimens of leather, tanned by means of a tanning solution derived from forest leaves. It has long been known, he said, that there exists in forest leaves a certain amount of tannic acid. Mr. Ira Wood, of Woodstock, Vt., has discovered that

the leaves of the maple, birch, and oak, will furnish a decoction for tanning, more valuable in its results, than any other liquid. The skins are prepared in precisely the same way as ordinary leather, and the leaves are used promiscuously. Five pounds of maple leaves, from decayed trees, to four gallons of water. The leaves and water are reduced to five degrees by the barkometer. The leather made by this process, is mainly used for upper leather, and appears very handsome. For sole-leather the tanning has to be very hard. Mr. Tinkham also exhibited a side of calf skin which had been tanned in three weeks.

The Chairman remarked that the manufacture of leather was next in importance and extent, to those of cotton, wool and iron. This country produces more leather than any other. Both hides and tanning bark were here comparatively cheap. The bark will grow more scarce, as the oak and hemlock disappear, in bringing new soil under cultivation. Some new source of tannin must be sought for, at no very distant day. The amount of tannin in the leaves mentioned, is extremely small. He found, on inquiry, that the specimens of leather exhibited, were tanned by means of leaves, and japonica or other material containing a large percentage of tannin. He feared the virtue of dried leaves, in this case, had been over estimated. Analysis of the leaf will settle the question.

The Chairman explained an improvement in petroleum lamps, made by the Rev. Dr. S. P. Grosvenor, of McGrawville, Courtland county, N. Y. The specimen exhibited will show the manner in which the inventor has prevented air from getting into the lamp through the openings in which the wick elevator moves. The inventor could not be present this evening, but he informs us that his main object was to guard against the explosions so common with the ordinary burner. He found these to arise from an explosive gas formed by a mixture of the vapor of the oil with atmospheric air. Hence he has taken great pains to make his burner perfectly air tight. He has found that the admission of air is not necessary to the operation of his lamp. The space made vacant by the combustion of the oil is filled by a non-explosive gas generated by the flame of the lamp. Repeated experiments have assured him of this fact. As is often the case, he was pleased to find that while obtaining his main object he also had secured other important advantages; the pressure upon the surface of the oil was more constant than with the ordinary burner, and hence the flame was more steady and uniform. He found too that the oily vapor arising from ordinary lamps, causing a nauseous

odor, and condensing upon the chimney and outside of the lamp, was completely avoided. For the same reasons the chimneys are less liable to break. The combustion being more perfect, less oil is used. The invention did not draw forth much discussion.

EFFECTS OF SALT WATER ON A SURFACE CONDENSER.

Mr. Charles E. Emery exhibited seamless tubes from a surface condenser in which the salt water of the harbor was used to cool the tubes containing steam. The tubes were eaten through in many places, yet the same kind of tubes are used on ocean steamers, and such tubes are not thus affected. The cause was ascribed to chemical action.

Adjourned.

October 15, 1868.

Professor SAMUEL D. TILLMAN in the chair; Mr. C. E. EMERY, Secretary.

THE SPECTROSCOPE IN ASTRONOMY.

Dr. Vanderweyde spoke at length on the use of the spectroscope in astronominal observations. The first part of his discourse was devoted to an exposition of the received vibratory theory of light, and the analogy between light and sound as the results of vibrations. He then described the method by which Huggins, of England, was enabled, with the spectroscope, to decide whether certain fixed stars were in reality fixed as regards their distance from the solar system. If they approach or recede there must be a change in the colors of their spectre, resulting from a difference in the number of waves producing light which reach us. This point is well illustrated by a change in the pitch of a note coming from a body in motion. Most persons have observed, while riding in a railway train, that the sound of the whistle of the locomotive on a train passing by in an opposite direction seems of lower pitch while receding than when approaching. This is accounted for by the fact that to produce a note of a given pitch, a given number of air waves must strike the ear in a given time. If the number of waves is increased, there is a rise in the pitch; if decreased, there is a fall. Sound travels at the rate of about 1,120 feet in a second, a change in the temperature of the air of course altering that rate. If two locomotives are approaching each other, each at the rate of thirty miles per hour, and the whistle on one sounds the note C, made by 522

vibrations per second, it will be heard on the other locomotive at a higher pitch than its real sound; the difference being due to the combined speed of the locomotives, amounting to eighty-eight feet per second. At the instant of passing the true tone is heard, and, as they recede, the pitch will seem as much lower as it was before higher than the true tone. The pitch will not descend below its first change, because the locomotives are separating with a uniform speed. So, likewise, a steamship sailing before the wind will not cross as many waves as she does when going at the same speed against the wind.

The change of pitch produced only by the very rapid movement of the source of sound may be compared to the change of tint in the spectrum of a heavenly body, as the result of its rapid motion to or from the observer. It will, however, be borne in mind that, to detect this change of tint, there must be a change of direction of the source of light. This subject gave rise to an extended debate, in which Drs. Parmelee, Rich, Bradley and others participated.

Solid Extract of Malt.

W. A. Wetherby, M. D., introduced a new article of diet made from malt, and after a brief reference to the forms of beverage derived from barley, and the objections to all of them, if taken, under certain conditions, into the system, remarked that this "concentrated extract of malt" contained no alcohol, and, from the peculiarity of its preparation, was incapable of undergoing the vinous or acetic fermentation. Six ounces of this extract contains as much nutriment as one-eighth of a bushel of the best malt. Mr. J. G. Hovey, the representative of this new article, was then introduced, who made still further explanation of its properties and uses.

New Kerosene Lamp.

An improved kerosene lamp, the invention of Mr. Hayden, of Connecticut, was then exhibited. Its novelty consisted in having a movable cup with perforated sides below the ring supporting the glass, which could be slipped down the wick tube far enough to allow the lamp to be filled, and the wick trimmed, without taking off or moving the glass shade. A lady present objected to the plan, because the bottom of the movable cup would soon be filled with the crusts removed from the wick, and which could not be got out without turning the lamp upside down. This difficulty the inventor can doubtless obviate.

BRICK MACHINE.

Specimens of brick were exhibited, made by the machine manufactured by Chambers & Co., of Philadelphia. A full description of the machine was given, the prominent peculiarity of which is that a continuous strip of clay of the exact width and depth of an ordinary brick is pressed out and cut off in pieces eight inches by means of a revolving knife. Over 50,000 bricks per day have been made with one machine. A fine working model of this machine was exhibited at the American Institute fair of 1865.

The Chairman presented the following important scientific notes:

THE BOURBONZE LAMP.

In this new French burner a mixture of coal gas and air is forced through a metallic plate containing minute perforations, and then through a fine tissue of platinum wire. A great number of gaseous jets are thus obtained which are lighted in the ordinary way. The platinum wire raised to a white heat gives out a light too intense for the naked eye. The illumination thus produced is said to be equal to the hydro-oxygen and lime light, while its cost, assuming that the lamp is durable, is much less than that.

MINARGENT.

This new alloy, which in color, tenacity, sound and specific gravity resembles silver, is found by analysis to be composed of 1,000 parts of copper, 700 of nickel, fifty of antimony, and ten of aluminum.

STARCH IN THE YOLK OF EGGS.

After the yolk has been treated with ether to separate the fatty matter, then with water, and finally with acetic acid, starch granules appear under the microscope, which, on being subjected to chemical tests, behave in the same manner vegetable starch does under the same tests.

LAVA.

M. Silvestri has analyzed lava from the last eruption of Vesuvius and finds the following constituents: Silica, 38.888; lime, 17.698; alumina, 14.127; soda, 10; potash, 1.19; protoxyd of iron, 12.696; magnesia, 3.333; manganese, .01; water, 2.065. The presence of ten per cent of soda is quite remarkable. This lava, after being vitrified by artificial fusion, has a specific gravity of 2.698; while that from the last eruption of Ætna, which occurred in 1865, on being subjected to

the same treatment, was found to have a density of only 1.972. In composition the two lavas do not differ materially.

Liquid Glue.

M. Knaffl states that this useful article, employed for mending porcelain, glass, mother of pearl, &c., is not nearly so good when prepared with vinegar and nitric acid as that obtained by the following process: Three parts of glue, broken in small pieces, should be covered with eight parts of water, and left to stand for some hours; one-half of hydrochloric acid, and three-fourths of sulphide of zinc must then be added, and the whole exposed to a temperature of from eighty-one to eighty-nine degrees C., that is, from ninety-one to 128 degrees Fahrenheit, during ten or twelve hours. The compound thus obtained does not gelatinize; and after it has been allowed to settle will be found ready for use.

Refining Sugar.

M. Monnier, of France, has devised a new process for refining sugar. He passes into a chamber containing crude sugar a current of anhydrous sulphuric acid; a bleaching action immediately ensues, three-fourths of the coloring matter is destroyed, while the sugar itself remains unchanged. The next operation is to impregnate the sugar with sulphurous acid by burning sulphur in an adjoining chamber. About four parts of sulphur are used for 1,000 parts of sugar. After this treatment the sugar is dissolved in water, and the sulphurous acid is neutralized by lime previously converted into sucrate of lime. It might be supposed that the sulphur acids would convert a portion of the cane sugar into grape sugar; but M. Monnier finds the proportion of uncrystallizable sugar is not increased by the operation, which lasts about forty-eight hours. This process gives the best results with strongly colored West India sugars.

The Coloring Matter of Persian Berries.

M. Schützenberger, at a *seance* of the French Academy, gave an account of his experiments with the coloring principles in Persian berries, which seem to settle a point in dispute between Gellaty and Lefort. These principles are soluble in water, but, on being boiled with sulphuric acid, they are transformed into yellow pigments, which are nearly insoluble. Gellaty affirmed that this transformation was in consequence of the decomposition of a glucoside. Subsequently,

Lefort averred that the change was only molecular, and that no sugar was formed. M. Schützenberger now confirms the views of Gellaty by boiling rhamnegine in very dilute sulphuric acid, from which he obtains sixty-five per cent of sugar and forty-two of insoluble coloring matter. The sugar is uncrystallizable and is an isomer of mannite. The coloring matter is not identical with quercetine, as M. Bolley had supposed.

INDIANITE.

This name is given to a composition invented by M. Boquet, a chemist of Havre, France, which consists of 100 parts of India rubber, fifteen of resin and ten of shellac. It becomes very hard in a short time, and may then be reduced to a liquid by the addition of bisulphide of carbon. When applied, it dries rapidly, and its power of adherence is such that it can scarcely be torn from the surface on which it has been laid. It is impervious to wet, and is not affected by heat or cold. It may be used on any kind of metal in ordinary use, as well as on wood and other building materials, and will protect articles exposed either to air or sea water. It is applied without any previous coating of paint directly to the substance to be protected. Iron reservoirs, used as aquariums, have been coated inside and outside with Indianite, and neither the reservoir nor the water within have been discolored by it in the slightest degree.

PHOTOGRAPHING THE SOLAR ECLIPSE OF 1868.

The North German expedition, consisting of Drs. Vogel, Fritsch, Thiele and Lenker, reached Cairo late in July and proceeded by the Red Sea steamer, through the Straits of Bab el Mandel to Aden, where they arrived on the second of August. Aden, a seaport on the Arabian coast, was purchased, nearly thirty years ago, by the East India Company, as a coal depot and mail station for its line of steamers. The eclipse at this point would last only three minutes, while in India it would be five; yet as scores of French and British observers were to operate much further eastward, the Germans decided to note the event an hour earlier at Aden, in order to compare their observations with those made in India, for the purpose of ascertaining whether the wonderful violet colored protuberances, seen during a total eclipse above the dark edge of the moon, were changed in form at the end of sixty minutes. The sky at Aden was cloudy nearly up to the time for observation; fortunately a rent in the clouds

occurred at the right moment, and six pictures of the complete eclipse were secured. The telescope used had a lens six inches in diameter, with a focus of six feet. The diameter of the picture was three-quarters of an inch. Two prominences appeared, their maxima being about 120 degrees apart, and on the opposite side a remarkable hook or horn, projecting to an immense height, estimated at nearly one-fourteenth of the diameter of the sun, or about 60,000 miles. No comparison of photographs taken at different stations has yet been made. The spectroscope examination in India has settled an important question regarding the character of these projections beyond the moon's edge. They are now supposed to be gaseous emanations.

Gold Quartz in New York.

Near Clinton, N. Y., an auriferous vein of quartz, varying in width from six to twelve inches, has been traced to a distance of 3,000 feet on the surface. Samples of it have been found to contain $15.45 per ton of gold and about three dollars of silver.

The Fall of Rain as Affected by the Moon.

Dr. George Dines has published in the "Proceedings of the Meteorological Society," tables of the rain fall during nearly every day of the moon's age for forty years, as found in the journal of Miss Caroline Moleworth, of Cobham Lodge, Surrey, England. From these data he drew the conclusion that the fall of rain is in no way influenced by the changes of the moon, or by the moon's age. Pliny Earl Chase, of Philadelphia, in a paper read before the American Philosophical Society, takes exception to the method of Mr. Dines, by which certain important variations are entirely eliminated. By regarding the day of each change of phase as the middle day of a week (counting the half sum of the fifth and twelfth days in the first quarter, and the half sum of the twentieth and twenty-seventh days in the third quarter) with the seven days aggregate furnished by Mr. Dine's tables, Mr. Chase has been enabled to construct a new table of the ratios of the number of rainy days from 1825 to 1864, by which, he says it may be seen that, notwithstanding the complete veiling of all disturbances which may be due to the moon's variable distance and declination, there was a marked tendency to increase at quadrature and to decrease at syzygy, both in the amount of rain and in the number of rainy days. Mr. Chase finds that the observations made at Pennsylvania Hospital, demonstrate the existence of similar tides

at Philadelphia. The aggregate, during forty years, at each station, exhibit the following ratios of weekly rainfall:

	Surrey.	Philadelphia.
Week of new moon	98.2	97.6
Week of first quarter	103.1	100.3
Week of full moon	97.4	95.8
Week of last quarter	101.4	106.3

Mr. Chase refers also to observations at Mussoorie, on the southern range of the Himalaya mountains, the mean results of which for thirteen years are as follows:

	Average daily fall.	Ratios.
Day of new moon	.402	86.2
Day of first quarter	.535	114.7
Day of full moon	.399	85.6
Day of last quarter	.529	113.5

LAYING RAILWAY TRACKS BY MACHINERY.

The San Francisco *Alta* contains the following: The railroad track-layer is an indubitable and decided success. It is now working along regularly at the rate of a mile a day, and it will do better when several small defects are remedied. Some of its work has been done at the rate of two miles in twelve hours; but one mile is considered its present working capacity. The contractor and directors of the Vallejo and Sacramento railroad, although most of them were skeptical, and some quite dissatisfied about the delays in getting it into operation, give it the highest praise, and have made their arrangements in reliance upon it. The machine is a car sixty feet long and ten feet wide. It has a small engine on board for handling ties and rails. The ties are carried on a common freight car behind, and conveyed by an endless chain over the top of the machine, laid down in their places on the track, and when enough are laid, a rail is put down on each side in a proper position, and spiked down. The track-layer then advances, and keeps on its work until the load of ties and rails is exhausted, when other car loads are brought. The machine is driven ahead by a locomotive, and the work is done so rapidly that sixty men are required to wait on it; but they do more work than twice as many could do by the old system, and the work is done quite as well. The chief contractor of the road gives it as his opinion that when the machine is improved by making a few changes in the method of handling rails and ties, the necessity of which changes is now apparent, it will be able to put down five or six miles per day unquestionably. This will render it possible to

lay down track twelve times as fast as the usual rate by hand, and it will do the work at less expense.

The items drew out some discussion, after which the association adjourned.

October 22, 1868.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

Dental Plates.

Dr. A. Preterre exhibited specimens of dental plates. The material of one of the plates was aluminum which was made in the required form by casting. Considerable discussion arose on the difficulty of soldering aluminum especially with any other material than the old silver solder. A superior solder was stated to have been recently discovered. The other specimen of dental plate was made of collodion, rendered solid, the material being called "Parksine," after Mr. Parks its discoverer. The collodion for this purpose is imported in thin sheets, and dissolved to a pasty mass in sulphuric ether, and then placed in molds, and subjected to pressure, until the evaporation of the ether reduces it to a sold form. The use of India rubber plates are found to be objectionable on account of the vermillion (sulphide of mercury) used in its manufacture inducing salivation in those using such rubber plates. The plate made of collodion is perfectly light in the mouth, as it adapts itself to it quite readily.

Dr. J. B. Rich remarked that this process of making collodion plates bids fair to be a most wonderful improvement. It appears to be a very great advance on the rubber plan. It is very light and elastic, and then it is very tough. The only difficulty is the color; the process for coloring it is a secret. The plates are pure collodion. The new material possesses the advantage that if one tooth breaks, another can be pressed in. The casts are made in a pasty condition.

The chairman remarked that gold was considered the best material for plates, however he had lately heard a lady, who had artificial teeth set in a gold plate, complain of a coppery taste produced in the mouth by the plate.

Dr. A. Preterre said this was due to the gold plate being too much alloyed with copper. Eighteen carat gold has no unpleasant taste.

Dr. J. B. Rich stated that he has a case, a lady who could keep rubber gums in her mouth. There are many conditions of the mouth

where these gums, after eating will be filled with comminuted food and saliva. Dr. Preterre has been most successful in producing the most perfect plates.

Dr. A. Preterre remarked that by taking a series of molds each larger than another he could enlarge the size of the tooth without having the mold in sections.

The secretary then read the following paper which occupied the remainder of the evening:

THE BEST MODES OF TESTING THE POWERS AND ECONOMY OF THE STEAM ENGINE.

By Charles E. Emery.
Late of the U. S. Navy and U. S. Steam Expansion Experiments.

The steam engine is the only motor that has successfully competed with or supplanted the changeable and uncertain power derived from animal muscle, and the natural forces of wind and water; and its varied adaptations and applications have brought it into general use throughout the civilized world, not only in stupendous water works and manufactories, and in furnishing reliable and rapid communication by land and sea, but also in reducing the physical exertions of both sexes in the less grand but more important operations of the producing community in the forest, field and farm house.

Surely, then, the steam engine is not an experiment. Years ago, it was made a success, and soon became a necessity; and notwithstanding the grand discoveries that have been made in theoretical and practical science, the steam engine has to this day remained unchanged in every important particular. The principal advance has been in the perfection and general adoption of the simple high pressure engine. Many of the so-called improvements were mere variations in form and in the details of construction, which often failed to produce as economical results as older well tried mechanism. Nearly all the true improvements have been in workmanship and in adaptations and applications to various uses. A few of the general principles which influence the economy of the steam engine have long been known, and our manufacturers have in very many cases claimed a superiority for their engines on account of alleged excellence in the details of the valve gear, or other mechanism, designed to secure the results promised by theory, forgetting that theoretical propositions are of little value, unless all the conditions assumed are the same as those in practice, which is rarely the case. It therefore often happens

that engines, which in the opinion of the educated engineer, possess many of the elements considered necessary for economical workings, do not have those elegant, moving details, which fix the attention of the amateur, and delight the eye of the skillful mechanic. Business men seek only to sell, and therefore push into chief importance such points as the purchaser can see and understand.

Statements are made also regarding actual performance, but they cannot be considered impartial, because the trials upon which they are founded are made by interested parties, with no competition present. We have therefore to conclude that the purchaser of a steam engine has to base his selection almost exclusively upon the excellence of simple, mechanical details; and having done this, if the engine works well, and especially if it does better than the old neglected one, with its worn out boilers, he is entirely self-satisfied, and ready to sign a recommendation to the public of the engine which he has selected, thereby benefiting the manufacturer, and flattering his own vanity. But little true progress can be made in this way, as each manufacturer and purchaser knows little more than the result of his own experience.

To bring the steam engine to a high standard of efficiency, accurate, comparative trials should be publicly made of every different system of construction. This would be most satisfactory, if it could be done in the same place, doing the same work, under the same circumstances. This would require the erection of costly experimental fixtures, which could be done by private enterprise for expected gains, or by the combination of several wealthy manufacturers, or, better, still, by some scientific organization. The majority of cases must, however, be reached by trying the steam machinery in the actual performance of the duty for which it has been purchased. We desire, then, in our present inquiry, to ascertain methods and means to test the power and economy of the steam engine in a strictly scientific manner, which shall be above criticism, and *also* under the practical circumstances of every day use.

We propose first to mention some of the *terms* in general use on the subject, then to discuss the ways and means employed to measure the power and its cost, and afterward to select proper units of comparison and point out the manner of their practical application.

A steam engine is simply a *heat* engine. The *heat* evolved by the combustion of fuel is imparted in the boiler to *water*, separating and agitating its molecules, and thus forming *steam*. The steam exerts

pressure, varied according to its density, upon all sides of the vessels in which it is inclosed. This pressure or *force* is measured in *pounds* per square inch. The elastic force of the steam acting upon the engine piston, produces *motion*, which is measured in feet. The combined effects of *force acting through distance* produce mechanical *work*, which is measured in *foot-pounds*. The number of foot-pounds which an engine is capable of developing in a given *time*, expresses the power of the engine. The unit of the power is one *horse power*, the value of which is conventionally fixed at 33,000 foot-pounds per minute.

In proportioning steam machinery for any particular purpose, the first thing to settle upon is the amount of power required, and this being fixed in all cases, within certain limits, *the practical question is to obtain a certain power at the least possible cost.*

We will first discuss the ways and means used to measure and determine

THE POWER.

As has been said, the power of an engine depends upon the *work*, done in a given time; and as work implies *force* and *motion*, we must ascertain three things before we can calculate the power, viz.: The *mean force* and the *distance* through which it is exerted; also the *time* required for the movement. Having these, we first ascertain the distance moved per minute, and this, multiplied by the mean force, gives the number of foot-pounds per minute, which, divided by 33,000, gives the *horse power*. The distance through which the force is exerted, is usually calculated from the number of revolutions made per minute by the engine, which can be ascertained approximately, by actual count, but better by means of a register. The speed of the engine is varied more or less by every change in the load, or in the pressure of steam, even when a governor is used; for a change in speed *must* take place before the governor can operate. The variations are small, with sensitive regulators, but in a majority of cases, would materially affect the result. The true plan, then, is to attach a register to the engine, the indications of which should be taken once an hour, to check mistakes, and in the calculations the revolutions per minute should be an average for the whole time through which the trial extends. If the power is to be calculated from the pressure on the piston, the piston movement is also used and ascertained by multiplying the revolutions per minute by

double the stroke of the engine (when the latter is double acting). When the tension of a belt or series of springs is to be used in calculating the power, the movement of each must also be found, and must be calculated from the speed of the engine. It will thus be seen that two elements of the *power* are easily ascertained, viz.: The *time* and the *distance* through which the force is exerted. The mean driving force is more difficult to obtain. There are two instruments in use for measuring this, viz.: The *indicator* and dynamometer. These two names are used in this paper in a restricted sense. The first is applied only to the well known steam engine indicator, and the latter to that form of dynamometer which is used to measure the force transmitted by revolving wheels or shafts.

It would be impossible, in the limits of this paper, to give a detailed description of the indicator. We therefore will mention only such features as are necessary to explain its mode of operation. The indicator is so constructed and attached that steam from the main cylinder presses upon one side of a small piston in the instrument, the atmosphere pressure being upon the other side. To the indicator piston is attached a spring and a pencil, the latter arranged to mark on paper. The predominating pressure on the indicator piston, whether of the steam or the atmosphere, extends or compresses the spring in proportion to the intensity of the pressure, and moves the pencil up and down on the paper. The paper is arranged on a drum, which is so connected that it has a side motion corresponding to that of the engine piston. Consequently, as the engine piston moves, the *paper* is moved *sideways*, and as the pressure changes, the *pencil* is correspondingly moved *up and down*, so that the figure or diagram, traced on the paper, is a combination of the two movements, and should show the pressure at each and all points of the stroke. The mean of a number of ordinates on the diagram, represents the mean pressure per square inch of piston, which, multiplied by the area of the piston, gives the total force which produces the piston movement, from which the power may be calculated, as has been before explained. The indicator is a beautiful instrument, of such great value to the steam engine, that it may be said to deserve the numerous words that have been spoken in its praise. Still in many cases, where it has hitherto been considered practically perfect, its indications are of the most deceitful and unreliable character. It shows very perfectly whether the valves are adjusted properly; and often, when applied to an engine which is

working improperly, a mere glance at the diagram will reveal the difficulty, and suggest the remedy. Large leaks in the valves or piston may also be detected in this way. The indicated pressure at the end of the stroke has very often been employed to determine the quantity of steam used by the engine.. Calculations founded on such a basis, are entirely worthless, as will be explained when treating of the cost of the power. It is customary, also, to calculate the friction from the indicator friction diagrams; but the system is often practically erroneous, as will be explained hereafter.

The indicator is chiefly employed, however, to determine the power of an engine, it being supposed that the diagram shows correctly the pressure at all parts of the stroke. Even this it fails to do under certain circumstances. The most perfect instrument must have *some* friction in its moving parts, and the pressure of the pencil on the paper adds considerable resistance. If, therefore, the pressure be ascending, the indicator will show less than it should; and when the pressure is descending, the instrument will show more than it ought. In either case, then, the length of the ordinates is increased during any change of pressure, whence the mean pressure indicated, is greater than actually exists in the cylinder. When the instrument is in order, a stiff indicator spring used, and the pencil adjusted to bear lightly on the paper, their accuracies are too small to require serious attention.

When the power is measured in the steam cylinder, by means of the indicator, it is difficult to ascertain accurately the *useful work* the engine is capable of performing. This can be done, approximately, by means of the indicator, as hereinafter explained, but a more satisfactory result is obtained by the use of the *dynamometer*. This instrument is made in many different forms. The friction dynamometer consists substantially, of half clamps, or boxes fitted to a revolving shaft, and kept from turning therewith, by a lever held in position by weights and a spring balance. When in use, the clamps are tightened until they create sufficient friction to absorb the power; the weights are then adjusted till they nearly balance. The amount of weight, the tension of the spring, and the speed of the shaft are then noted, when the power transmitted through the shaft may easily be calculated; for the force of the weight and spring is multiplied by the lever in proportion to its length, divided by the radius of the shaft, and this multiplied by the velocity of the bearing surface in feet, per minute, gives the foot-pounds. This form of dynamometer is little used, because it

absorbs instead of transmitting the power. Besides, it is difficult, on a large scale, to maintain a constant friction for any length of time.

The dynamometers of greatest practical value transmit, and at the same time indicate the power, without in any way interfering with the regular duty of the engine. For instance, if the power be transmitted by means of a belt, and we can in any way measure the tension of the two parts, their difference represents a force moving with a given velocity, which may easily be reduced to units of power.

A dynamometer on this principle has been used abroad, which was re-invented by Horatio Allen, Esq., President of The Novelty Iron Works, in this city, and by him applied to the engines used in the U. S. Steam Expansion Experiments. In this case the driving and receiving shaft lay in the same horizontal line. Near the contiguous ends, large wheels were placed with a V groove in the circumference of each. An endless rope passed in both directions over the top of one wheel, then under side pulleys over the top of the other wheel. The side pulleys were below the center of the large wheels, and were of such size that the four parts of the rope leading to them hung vertically. These pulleys ran in bearings free to slide vertically, and were connected to platforms carrying adjustable weights. The motion of the wheel, on the engine shaft, turned the other shaft in the opposite direction, by means of the rope, but tended, at the same time, to lift the side pulley. The opposite side pulley was weighted sufficiently to keep the rope from slipping, and weights and a small spring were adjusted on the driving side to balance the lifting force. Then half the difference in weight on the two side-wheels equaled the tension of the cord, or the driving force, which, together with the velocity of the cord, furnished the only elements necessary to calculate the power. This instrument had means attached to automatically record the strain on the cord, and answered its purpose very perfectly and satisfactorily. It was, however, too expensive and cumbersome for every day use. Three beveled wheels, on the above principle, have been used as a governor, and would doubtless make a good dynamometer also.

Steel springs, properly arranged, form, we believe, the best dynamometer for practical use. As commonly constructed, a pulley, through which the power is transmitted, is made loose on the shaft and then is driven from it, through the intervention of springs; or one shaft is driven from another in the same manner. It is necessary, then, in order to calculate the power, to ascertain the tension of the

springs, and their velocity, where the force is applied. Neer's rotary dynamometer, on this principle, may be taken as a type of its kind, and has given general satisfaction.

The accuracy of an instrument of this kind can easily be tested by weighing the springs, measuring the distance from the center at which they act, and correcting the dials accordingly.

A good dynamometer is the only instrument that can be depended upon to accurately measure the useful work which an engine is capable of performing; still, the best instruments of this kind have many disadvantages for every day practical use.

In the first place, especially when great power is to be measured, the dynamometer must needs be a large, heavy, and expensive measuring machine, rather than an instrument; consequently, but few can afford to purchase it. The dynamometers, at present in the market, are sold chiefly to establishments that rent rooms with power, where a small machine can be shifted about the building in the night, and so attached as next day to indicate the power used by one of the tenants.

The steam indicator, on the contrary, is neat and compact, and can be easily applied to nearly every kind of steam engine. Its use has, therefore, become so general, that it is acknowledged throughout the world as the standard measure of the power of the steam engine. This instrument is not perfect; still we cannot point out another, fit in every respect, to take its place. The dynamometer is the more perfect instrument; but we acknowledge that, in a majority of cases, it is impracticable to apply it. Then, as we have proposed two methods of investigation, one for careful scientific experiment, and the other for practical and tolerably accurate comparison, we conclude that the first would always require the use of the dynamometer, and the latter whenever it is practicable to employ it. Generally, however, until a new instrument is perfected, we must use the indicator alone in ordinary practical trials.

When the indicated power alone is used, it is important to know the probable friction of the engine, so that the net power, or that portion available for useful work, may be estimated. A favorite method is to take an indicator friction diagram from the engine, when disconnected from its load, and running at its working speed. The mean friction pressure thus obtained is supposed to be constant at all loads. Hence it is usual to deduct from the indicated working pressure the indicated friction pressure previously obtained, when the

remainder represents the force available to produce motion. From this, however, is deducted the friction of the load, usually called seven and a half per cent; and the net power is calculated from the second remainder. For instance, if the mean working pressure is forty-two pounds, and the friction pressure two pounds, forty pounds is available to produce motion without a load; and seven and one half per cent of this, or three pounds, represents the friction of the load; so that five pounds pressure is lost in friction, or about twelve per cent of the whole. This mode of calculation cannot always be depended upon. We have known a case where the mean indicated working pressure in the cylinder was only eight pounds, and the friction pressure two pounds. Consequently, by the above method, about thirty per cent of the power was absorbed by friction; but the dynamometer showed that less than ten per cent was lost in that way. Similar cases, differing only in extent, will be found quite frequent. The reason is, that engines are packed for the working, and not for the friction pressure. If the steam pressure be 100 pounds, the packing must embrace the piston and valve rods with sufficient force to prevent leakage, or say 105 pounds for every square inch of surface packed; and nearly the whole of this will produce friction, when a low pressure is used, but the full pressure will work in between the surfaces, and force back the packing during the steam stroke, so that the friction from that source will be least when the engine is doing its regular duty. Spring packed pistons modify the friction in the same way. In very large engines the state of the packing would have little influence on the friction, though it certainly would seem proper to loosen the stuffing boxes before taking friction diagrams. In some cases, engines are so weakly constructed, that, though the indicator may show little friction, without a load, there will really be a great loss when the work is being done, due to parts springing out of line, etc. The dynamometer furnishes, therefore, the only true means of obtaining the net power. In well constructed engines we should be able to calculate the friction by regarding the weight of the moving parts as part of the load, which is moving with a certain velocity in bearings of a given material, and having therefore a co-efficient of friction varying between five and eight per cent. For ordinary purposes, when trial is not convenient, we may assume the friction of small engines, of bad design, or of any engine with weak framing, as being from twenty to twenty-five per cent of the indicated power; while in good engines, of ordi-

nary shape and proportions, it is sufficient to allow fifteen per cent for medium size, and as low as ten per cent or even eight per cent, in exceptional cases, in large engines of solid construction and good workmanship.

Having described the instruments used in determining the power of the steam engine, we propose to postpone future remarks upon the proper methods of their application and use, until the closing general discussions; and we will now proceed with the next branch of inquiry; namely:

THE ECONOMY OR COST OF THE POWER.

Money is the standard unit of value. Hence, everything which costs money, that is required in order to obtain the steam power in any case, is a proper charge to the cost of the power. Therefore, strictly speaking, the cost of the fuel, of the oil, and of needed repairs, together with the wages of the attendants, and also, perhaps a sinking fund for prospective renewals, should all form part of the aggregate cost. Nor should either of these items be neglected. It would be poor economy for a person to purchase an engine designed to save fuel, which, for any reason was liable to frequent derangement; for it is not alone the cost of the repairs which are to be considered, but the losses which occur from stopping work in the mill or factory. We cannot, however, in our present inquiry, discuss matters of design (though they should always be considered by a purchaser), but must confine ourselves to the methods and means employed to ascertain the economy of fuel.

The combustion of the fuel evolves heat, which uses water as a vehicle, and is carried with it to the engine, and there produces the power. The true measure of the cost, then, is the quantity of heat required to perform a certain quantity of work. Heat being imponderable, can be measured only by its effects on other bodies. The standard unit of heat, or "heat unit," is the heat required to raise the temperature of one pound of distilled water at thirty-nine degrees one degree Fahrenheit. The mechanical equivalent of a unit of heat is 772 foot-pounds of work; but the best steam engines obtain only about one-tenth of that quantity. Such a result has often been regretted by scientific minds, and many have spoken of it as mysterious. We consider the steam engine of to-day very defective. Some of the defects are inherent; they can be pointed out, but cannot be remedied without changing the general principles of

construction. The majority of the practical loss has, however, never been satisfactorily explained. The writer, like others, has his own theories on the subject, but he has no desire to present them publicly till they have been tested; for if they be correct, the principal difficulties can be removed. Few appreciate the extent of the losses in the steam engine. It is only the best examples that utilize even one-tenth of the heat. In such cases, one-tenth is condensed for the work, and about four-tenths is wasted in the clearances and the exhausting steam, even when expansion is carried on, until the terminal equals the back pressure. The remaining five-tenths are imperfectly accounted for. Cases are not unfrequent where only three to five per cent of the heat taken from the boiler is utilized in work. The discrepancies occur chiefly at the higher grades of expansion. Without expansion, it is easy to understand that most of the heat must go away with the exhaust.

When steam is generated by the application of heat in the boiler, to water only, the water, in becoming steam, always takes up a certain fixed quantity of heat; in other words, becomes saturated with it, and forms saturated steam. Hence, if we can measure the water evaporated, to produce the power of an engine, we can easily estimate the quantity of heat used. The feed water is therefore a perfect measure of the comparative cost of the power, when evaporated in a good boiler, having no superheating surface. The economy of steam machinery is, however, generally measured by the amount of coal or other fuel consumed to perform a certain quantity of work. The conventional standard of comparison between all kinds of engines is, the number of pounds of coal burned per indicated horse-power per hour. The indicated power can be obtained with comparative ease, as has been explained; so also can the coal per hour. Hence the above standard has the merit of great simplicity, and consequently is used by all nations. We must therefore adopt it, or at least use it, in order to be able to compare our results with those of others; still the method is liable to very considerable errors, which we will examine with a view of correcting them.

It has been shown that the indicated power is not always proportioned to the useful work. The qualities of coal vary so much, also, in different localities, that the amount consumed does not furnish an accurate comparative measure of the cost of the power. When the coal measure alone is used, too, the engines and boilers are both tested together, which gives no opportunity to ascertain which of the two is

entitled to the credit of the performance. This standard will not then answer the purpose of a scientific investigation. In such case, we must ascertain, in addition to the coal, the amount of water evaporated; we can then estimate the value of the coal, and the separate efficiency of both the engine and boiler. The value of the coal, and the efficiency of the boiler, are shown by the number of pounds of water evaporated per pound of coal, and the economy of the engine as compared with that of others by calculating the number of pounds of steam used per horse-power per hour. The weight of the steam used is, of course, the same as that of the water evaporated.

In all ordinary practical trials, the economy must be determined simply by the quantity of fuel consumed to produce the power. Hence, we will first try and find a solution of the difficulties which attend this kind of measurement.

THE FUEL.

The different kinds of fuel vary so much in value that it is impossible to accurately compare them. Coal being most generally used, is the natural standard; but there are so many varieties of this necessary article, varying greatly in quality, that it seems a hopeless task to try and compare the performance of steam engines in different parts of the world, or even of our own country, by the consumption of differing coal, which may vary twenty per cent in heat-producing power. The best way is, evidently, in comparative trials, to use selected coal from the same mine. Yet, how rarely can this be done; and even if this precaution be taken in certain cases, how can a comparison be made with the results obtained by others widely separated, and possessing, possibly, differing views? We must say that the problem cannot be solved with scientific accuracy; still we are able to suggest some corrections which will reduce all varieties of good coal to substantially the same standard, and thus unable us to use this measure in simple practical trials.

We cannot examine in this paper, with any minuteness, the chemical constituents of the different varieties of coal. For our purpose, we will simply divide them into two portions: namely, the non-combustible and combustible.

The non-combustible portion consists, for the most part, of earthy matters, though oxygen and nitrogen gases are often present; and most coals absorb considerable water. The combustible portion consists of carbon and hydrogen, the first largely predominating. In

American anthracite, about three per cent of the combustible is hydrogen. The semi-anthracite combustible contains about five per cent; and the bituminous varieties a larger proportion, varying with the locality of the mines. It is authoritatively stated, that in some varieties of Ohio and west Pennsylvania coal, the hydrogen element is often twenty-four per cent of the whole combustible. For the consumption of equal weights of hydrogen and carbon, the first requires three times as much oxygen as the latter; the heat resulting should, therefore, bear a somewhat similar proportion. Favre, Silberman, Andrews, and others, have, for experiment, estimated the calorific value of one pound of carbon to be the heating of about 14,000 pounds of water, one degree Fahrenheit. The corresponding value of hydrogen was similarly determined to be about 60,000 heat units. Bituminous coal, containing considerable hydrogen, should therefore produce very much more heat in combustion than anthracite; but in practice the difference is comparatively small. Mere differences in mechanical structure appear to have a greater influence than chemical constitution. The reason is not evident.

The latent heat of the steam resulting from the combustion of hydrogen, which is lost in the atmosphere, will not nearly account for the discrepancy. Without attempting an explanation, except, perhaps, imperfect combustion, we can, for our purpose, only turn to the records of practical experiments, and find what different kinds of coal have done, and may therefore be expected to do again.

Bourne gives the evaporation efficiency of thirty varieties of coal, from different parts of the British Isles, or from 7 to 10.2 pounds of water from a temperature of 212 degrees. The average was 8.7 pounds. The coals are, as is well known, of the soft or bituminous variety. The results of experiments made by the navy department, with thirteen varieties of American anthracite, from different parts of the Pennsylvania coal field, gave a mean evaporative efficiency per pound of coal of 8.9 pounds of water, from a temperature of 212 degrees Fahrenheit. Three specimens of American bituminous coal gave a mean result of 9.9 pounds under similar conditions. The figures make it appear that our American coals are superior to those of other nations. Professor Johnson, at an earlier period, made some experiments for our government, with smaller quantities, but obtained more marked results in the same direction. On the contrary, the engineers of the English and French steamers, out of this port, speak of our Cumberland and kindred varieties of coal as inferior to those

procured at home. We are in search of the truth, and cannot, therefore cater to national vanity. Our best bituminous and clean, free burning anthracite coals are undoubtedly better than can be found in large quantities in any other part of the globe. All must admit, however, that some of our American bituminous coals are almost identical with the English in appearance and chemical constitution. Both should therefore give the same results, when tested under the same circumstances. In the experiments above mentioned, the English coals comprised a greater number of kinds, the bad being averaged with the good. The United States government experiments were tried with the greatest care, and in a boiler better proportioned for economy, probably, than the average in England. On the whole, we think it fair to assume that the English and American bituminous coals, of the qualities ordinarily supplied to the market, are substantially equal in value, though selected varieties, fresh from our mines, would of course give much better results.

The government experiments above mentioned, showed that the evaporative efficiency of the American anthracite, and the American bituminous coals are in the proportion of 8.9 to 9.9.

The anthracite as a rule, contains much more refuse than the other varieties. The English coals probably average ten per cent of waste the west Pennsylvania and Ohio coals have only five per cent, and the maximum of our bituminous coals rarely exceeds thirteen per cent. On the contrary, the refuse from anthracite rarely falls as low as ten per cent., and often reaches to twenty-four per cent, so that, on the average, its waste is double that of the bituminous varieties. It will therefore be interesting for us to examine the results produced by the combustible portions of the different kinds of coal. The part consumed is called the "combustible," and is found by deducting from the weight of the coal the weight of the ashes, clinkers, soot, &c., which can be collected after the trial. Referring again to the navy experiments, we find that the mean evaporative efficiency of thirteen varieties of American anthracite combustible was equal to the evaporation of 10.69 pounds of water, from a temperature of 212 degrees, and for the three varieties of bituminous combustible, the corresponding effect was 10.84 pounds. The results are practically identical. By throwing out of the comparison some of the varieties of anthracite, which justly have a poor reputation in the market, the preponderance would be upon the other side. If, then, we take it for granted that the average foreign

and American and bituminous coals are substantially equal in value, the value of the combustible of the foreign coal will equal that of American bituminous and American anthracite, and we may assume that the combustible of the coal, burned in any case, is a tolerably accurate comparative measure of the economy of a steam engine. All these restrictive qualifications are necessary, for if selected coal of the best quality, be used in a trial, the results will be above the average in any case. We wish simply to indicate that the greatest difference in the results given by different coals is due to the difference in the quantity of non-combustible matter, so that, if this be thrown out, the weight of the combustible remaining gives the nearest approach possible, without absolute trial, to the comparative heat-producing powers of different specimens. The best standard to show the comparative economy of the steam engine, other than that of the steam used, is therefore, "The number of pounds of combustible used per horse-power per hour."

We cannot fairly, however, compare the combustible per horse-power per hour, used in experiments here, with other experiments where only the coal was noted. This necessitates us to correct the amount of coal used by a common standard, founded on the combustible. Good bituminous coals, here and in England, have about ten per cent refuse; hence, to make our experiments compare with those abroad, as well as for convenience, we suggest that in every case, the coal burned in determining the economy of a steam engine be reduced to a common standard of ten per cent refuse. Let us see the effect of this. The true comparative test for engines is the amount of heat they receive. We have shown that the heat-producing power of the coal is proportioned to the weight of the combustible; hence, if the weight of the coal be also proportioned to that of the combustible, it also expresses the relative economy. The coal is so proportioned when it leaves the same percentage of refuse; so by our plan of correcting the weight of the coal by its combustible, so as to give ten per cent refuse in each case, the weight of the coal is a true comparative test of the relative economy of the engine. For instance, one hundred pounds of coal, leaving twenty per cent refuse, will evaporate no more water than 88.9 pounds, leaving ten per cent refuse, for both contain only eighty pounds of combustible. If to the combustible we add one-ninth of its weight, the quantity added is one-tenth or ten per cent of the sum, which represents the weight of the coal, corrected to the uniform standard of ten per cent

refuse. Suppose a horse-power in a certain foreign steamship costs 2.8 pounds of bituminous coal per hour, and in an American vessel it costs three pounds of coal, using anthracite, are we to say our engines are inferior? Let us see. We first deduct the refuse from the anthracite, for instance, twenty per cent, which leaves 2.4 pounds of combustible. This, then, is nine-tenths of the weight of coal having ten per cent of refuse; so multiply 2.4 by $\frac{10}{9}$, gives 2.67 pounds as the true cost of the power in the American engine, to compare with 2.8 pounds used by the foreigner, when both are compared by the same standard.

We have been thus explicit, because the fuel is so generally used in the comparison of the performance of steam engines. The coal bills, of course, show the absolute cost of the power in any particular case, no matter what quality of coal was used; but under such circumstances, the weight of coal consumed, even when corrected as above pointed out, is, as must be seen, but an imperfect *comparative* measure. To make comparisons sufficiently correct to answer the demands of science, we must measure the steam used in each case; in other words, compare engines by the number of pounds of steam used per horse-power per hour.

The calculations are usually made from the pressure shown at the termination of the stroke; the assumption being that the engine uses, at every stroke, one full cylinder of steam at that pressure. In other cases, however, the initial pressure, and the portion of the cylinder filled at the point of cut-off, are used in the calculation. These methods of determination pre-suppose that dry or saturated steam enters the cylinder, which may be true, and that the steam continues in this state, through at least part of the stroke, without condensation, which is never the case. Steam is necessarily condensed to set free the heat transmuted into the work done; and the temperature of the metal of the cylinder is a mean of the temperatures to which it is subjected, and therefore the surfaces form a condenser with respect to the initial steam. The consequence is, that there is always more steam taken from the boiler than is shown by the indicator; the discrepancy increasing with the degree of expansion and amount of external refrigeration. Clarke, in his work on the locomotive, points out great differences between the amount of steam calculated from the initial and terminal pressures shown by the indicator; and yet uses the first in all his calculations. Later experiments, where the steam has been actually measured, show that in small engines twenty

to thirty per cent of the steam is unaccounted for by the indicator at full stroke; and as high as sixty to eighty per cent when the steam is expanded considerably. Large engines show a small discrepancy at full stroke, which rises to thirty, and often fifty per cent, with shorter admissions. The best examples of the English double cylinder pumping engines, with steam-jacketed cylinders, use thirty-three per cent more steam than is shown by the indicator on the cylinders. This method of determination is, therefore, absolutely worthless for our purpose, as it furnishes no basis for reliable comparative tests. These discrepancies show us where a great loss takes place in the use of the steam engine. They have been ascertained, in practice, by indicating the engine and measuring the water pumped into the boiler, and evaporated there, to furnish steam. In other cases, the exhaust steam of the engine has, by surface condensation, been reduced to water, and its quantity determined by measuring or weighing it. The weight of feed-water, or what is the same thing, of steam used in any case, to produce a given power, may, by either of these plans, be ascertained with scrupulous accuracy; and if the coal be weighed at the same time, the evaporative efficiency of the boiler can also be determined, and the excellence of both engine and boiler be detected and credited aright.

In addition to the standards above given, expressing the economy of the engine, others of special application are used, which give the cost in terms of that for which money is paid, namely, the coal, and the result in that which returns the money. For instance, the miller speaks of the number of pounds of coal it requires to grind a barrel of flour; a thing, by the way, which may depend as much upon the condition of the mill as of the steam machinery. Locomotives are rated by the number of pounds of coal or coke burned per ton per mile. So, also, what is known as the "duty" of a pumping engine, is the number of foot-pounds of work derived from the consumption of a certain quantity of coal.

Having discussed the various measures and means that may be employed for our purpose, we desire next to select such as will be useful in particular cases, and show their practical application, which leads us to

The Methods of conducting Experiments.—I. Testing Boilers.

The power of an engine can never exceed that of the boiler which furnishes it with steam; hence, it is eminently proper that we

should first select measures to ascertain, in a given instance, whether the steam is economically generated. As has been said, the heat-producing power or evaporative efficiency of a boiler is measured by the number of pounds of water evaporated per pound of coal from a given temperature, say 212 Fahrenheit. We have, therefore, to weigh the water evaporated, and the coal producing the evaporation, a very simple thing, apparently, but one about which there is much misapprehension, resulting in statements grossly erroneous and ridiculous. The water may be measured in a tank or barrel, the contents of which has been ascertained, by careful measurement, or by weighing water into it of a given temperature. When experimenting, the water in the tank should be pumped out dry, if possible, or at least to a given mark; the pump then stopped, the tank refilled to the proper height (the easiest way is to overflow it), when the supply can be shut off and the operation repeated. The supply pipe should be arranged so that the water can be seen entering the tank, and leakage detected while the pump is working. The better way is to have a hose, to throw in and out of the measuring tank. Before making an experiment, it should be ascertained if the boiler foams, or raises water; if so, it must be remedied before proceeding further. All leaks about the tank, pump and boiler should be stopped; and all extra pipes leading water in or out of the boiler be disconnected, or frequently examined. The steam generated may be worked off in the engine, blown off through the safety valves, or otherwise disposed of, so long as no water is lifted with it. The latter is less liable to happen when the evaporation takes place under considerable pressure. The greatest care is necessary in commencing and ending experiments. There are several methods of doing this. The first is, to measure the temperature and height of the water in the boiler, and immediately upon starting the fire, to keep an account of the fuel consumed until the close of the experiment; then to weigh the coal and ashes hauled out of the furnace. This involves a calculation to ascertain the heating effect of the fuel used in generating steam. It is of little value, for the purpose of comparison, for the shell of the boiler and its surroundings (often a heavy mass of brick work) has also to be heated, and of this no estimate can be formed. Another plan often adopted is to get up steam with wood, and allow it to burn low, leaving only sufficient fire to start the coal. The experiment is started when the first coal is put in the furnace, and

terminated when the last coal is nearly burned. This plan is supposed to give an accurate measure of the coal burned. The better plan is, to get everything in average working condition before starting to experiment. The steam should have the proper pressure; the fire be clean, and of a certain thickness, judging by marks on the sides of the furnace; the ash-pits clean, and the water at a certain known height. The experiment may then proceed, weighing all the coal afterward used, and measuring the water pumped into the boiler, till near the desired time to stop, when the fire should be thoroughly cleaned and filled up with coal to the same marks as at the beginning, and should be maintained at that point, with the steam at the starting pressure, till after pumping in the last tank of water, when, as soon as the water level reaches the same height as at starting, the experiment may be terminated. The ashes in the pit should then be weighed, as well as those previously collected. The fire should be equally bright, and the steam pressure the same at the beginning and end of the experiment, so that the water level will be disturbed in like manner. At starting and stopping, a certain feed should be kept on, or the water should be pumped too high, and time noted when, by evaporation, the level falls to the mark. No experiment should be less than eight hours in length, and a trial of forty-eight to seventy-two hours' duration can better be depended upon. During the experiment a log should be kept, upon which should be recorded the time, the weight of the ashes, the number of tanks of feed water, and the temperature of each. The temperature of the escaping products of combustion and of the fire room may also be noted, as well as any evident remarks about the kind of coal, and the circumstances of the trial. After the experiment, the following calculations are necessary: First, in an evident manner, ascertain the total amount of coal and ashes; subtract one from the other, which gives the total weight of the combustible. Then find the average temperature of the feed water and the average pressure of steam, and calculate the weight of the whole quantity of water evaporated, making allowance for its temperature.

The next step is to find the quantity of water evaporated from a constant temperature, say 212 degrees. From formula or tables find the total heat of the steam due to its mean total pressure; from this deduct the total heat which the water contained before entering the boiler. The result is the number of units of heat imparted to each pound of water. Divide this by the latent heat of steam at 212

degrees, and multiply the quotient by the total number of pounds of water evaporated at the observed pressure; the result will be the total evaporation from our supposed temperature of 212 degrees, and at atmospheric pressure. The latter divided by the total amount of coal burned, or, if desired, by the combustible, gives the final result, in the usual comparative terms, viz.: *The number of pounds of water evaporated per pound of coal* (or combustible). The coal may be corrected to a uniform rate of ten per cent refuse, as has been before explained.

We have reason to suppose that in many experiments abroad, the ashes were "weighed back," and credited on the coal account; in other words, that what is reported as coal was really only the combustible portion thereof. In purchasing coal, we pay as much for the ashes as for the combustible, and ships must carry both, in a combined state; therefore the report of every experiment should clearly state what is meant by the word coal, if that be the term employed, whether the weight of the coal as actually purchased, that of its combustible, or a weight proportioned to the combustible, on our plan of correcting to a standard of ten per cent refuse.

Testing Engines.

We will examine, first, a simple mode, which may be practically applied, in any case, to test the economy of steam machinery, in the actual performance of its regular duty. In ordinary trials, when but little care and expense can be afforded, the engine and boilers must be tested as a whole, the comparison being made by the "*number of pounds of coal consumed per indicated horse-power per hour.*" The indicator is used to measure the power, because, as has been before explained, it is the simplest device we have for this purpose, and most generally applicable. We first desire to give, from our experience, some directions about the use of the indicator, and the manner of attaching it to the engine. Since the invention of the "Richards" or "Porter indicator," the direct-acting instrument known as the "McNaught indicator," has fallen into disuse, except on engines working very slowly. We will make our remarks more especially applicable, then, to the first instrument, often called the "parallel motion indicator." Before using the instrument, see that it is correctly made and in good order. See that the spring screws down squarely on the piston, and does not tend to one side, and thus make friction in the guide of the piston rod. Examine every joint, and see

that it is free, without shake; see if the two links are parallel at all times, and the radius arms at mid position; if not, the arrangement is not a parallel motion, and must be corrected. See that the arm carrying the levers has no vertical shake; see that the barrel runs true, and adjust a pencil in place to bear lightly upon it. The scale of the indicator should be tested by a mercury gauge, and the mark on the spring corrected accordingly. This is important, for the reputed scale is rarely correct, and during repairs it is often varied. The instrument should never be connected to the cylinder *ports;* nor in any position where a current passes the connecting pipe. The connection should be large, short, and direct. Be careful to give the barrel the correct reduced motion of the engine piston. Other details may be arranged as convenient. The instrument should be thoroughly heated before taking a diagram or marking the atmospheric line. The pencil should be made to bear as lightly as it will make a mark, and it should be allowed to run over the paper several times. Both ends of the cylinder should be indicated.

Before beginning an experiment, both engine and boiler should be in average working condition. At the commencement the fire should be clean, and its thickness noted. The contents of the ash-pit should then be removed, and the coal be weighed, the same as in testing boilers. Indicator diagrams should be taken once an hour, or every half hour, or even less, if the load varies considerably. The pencil should be allowed to remain on each diagram a considerable time, to get a fair average. A register or counter should be attached to the engine, the indications of which should be noted at the beginning and end of the experiment, and every even hour intervening. If a register cannot be obtained, the revolutions should be counted and recorded every fifteen minutes. This should be continued not less than eight hours, and a longer time is preferable. At the end of the experiment the fire should be clean, and of the same thickness as at the beginning, the same as in testing boilers. A log should be kept during the progress of the experiment, showing the time, pressure of steam, revolutions of engine, weight of coal and ashes, and other matters of interest. The calculations are simple, and need not be detailed. We will here remark that the fault with most experiments is the short time for which they are tested. To ascertain accurately the consumption of fuel in a given case, requires, as has been said, at least eight hours continuous action, and the mean power cannot be obtained, in many instances, in much less time. A single diagram, taken occasionally,

gives little idea of the actual power exerted, for in every manufactory the load is constantly changing. It is more than probable that the excellent results claimed in many cases are obtained by calculating the power from a diagram taken with the full load on, and the cost of the power from the average coal, or worse yet, from the coal which is thrown in the furnace in any particular hour, without noting whether the fire is heavier at the beginning of the hour than at the end. A manufacturer's coal bills always tell him what his steam-power has cost for a given time, but his one hundred horse-power engine might have been exerting, on the average, only fifty horse-power; so, without actual and careful observation, no results can be obtained of any value to the engineering profession. The only true way is to make thorough trials, and repeat them until the results practically coincide.

When the power of the engine is measured by a dynamometer, the same care should be taken to frequently record the revolutions of the engine and the indications of the instrument, so as to be able to calculate the true average power. Fuller reasons for such precautions have already been given in the preceding discussion.

We are now prepared to select the methods and means necessary for a scientific trial of the economy of steam machinery, which shall be complete and above criticism. We must first bear in mind that it is the *economy* that we wish to test, and not the excellent manner in which some device controls the speed of the engine under varying loads. Special trials may be made of each detail, if desired, but only one thing can be tested at a time. To get accurate results, great uniformity is necessary. The closer the resemblance between the records, at different times, the more correct will be the averages. It is essential, then, to carry a uniform pressure of steam, and to have a uniform load and speed to the engine. In regular practice the load is necessarily varied somewhat, which can only be provided against by frequent observations; but our remarks are more particularly applicable to an establishment fitted up especially to test steam machinery, and in other trials details must be varied according to circumstances. In such case the boiler should be of ample size to do the work, and the pressure should be regulated by a steam damper. The resistance should consist of wind or water wheels, or pumps. We prefer high speed fans or blowers, as the resistance can then be easily regulated by varying the size of the discharge openings. Tanks should be provided for measuring the feed water of the boiler, and it would be well,

though not strictly necessary, to have a surface condenser, from which to collect and measure the distilled water, and thus, in two ways, ascertain the quantity of steam used. The power of the engine should be measured both by the indicator and dynamometer, and duplicate registers should be provided to count the revolutions. The better plan, in order to give the same area of indicator diagram, is to use, in each experiment, a cut-off, fixed at any desired point, and *not* use the governor. In such case, special means must be provided to keep up a uniform lubrication, which, with the uniform resistance proposed, will secure uniform speed.

When experimenting, the coal should be weighed, and the feed water measured, or weighed, with all the accuracy required for testing boilers. At the same time, indicator diagrams should be taken at least once an hour, and the reading of the dynamometer recorded. A record should also be kept of the time, revolutions of engine, steam pressure, and the temperature of the feed water, and in a condensing engine, of the hot well and circulating or condensing water. The temperature of the engine and fire room, and of the external air, should also be noted, to show the effect on condensation in the pipes and passages. The direction and force of the wind is also useful, to show its influence on the fires. Barometrical observations are essential, to show the true zero of the steam pressures. Experiments conducted thus carefully, and with such apparatus, would furnish results of the greatest value to science. Each trial would show the economy of the boiler and of the engine, also the friction of the engine and its load, and the net power and its cost; besides affording much valuable information to aid in the explanation of the losses which now exist in the steam engine, and suggesting improvements in its construction. The United States expansion experiments were tried, substantially, on this plan, but were stopped when results were being obtained of the greatest interest. Could an experimental establishment be now opened to manufacturers and inventors, how much capital, physical exertion, and mental anxiety could he saved, and how greatly the steam-engine might be improved. Without such a place, however, much good can be done, if every engineer will carefully use the means at his command, and record the results. The awards at all our fairs should be based upon trial, and not upon mere opinion.

The "yankees" are an ingenious people. Let all assist in directing this ingenuity into scientific channels, and the character of the

result may be judged from the present advanced position of our high-pressure engines. By fully discussing the subject of economy, and generally circulating complete records of competitive trials, an important branch of industry will be stimulated, all classes benefited and American engineering become the standard throughout the civilized world.

Adjourned.

October 29, 1868.

Professor S. D. TILLMAN in the chair; Mr. C. E. EMERY, Secretary.

PIANOS FOR CHILDREN.

Mr. Theodore Roz exhibited his infants' key-board for the piano. This board is intended to be placed on any piano, when used by children, and each key struck operates a corresponding one on the piano. By this arrangement the small hands of children are enabled to strike the octave. This key-board is intended as an attachment to the piano. Mr. Roz has also a key-board to transpose a tune from one key to another.

IMPROVED SCREW DRIVER.

Mr. Edgar J. Amor showed his combined screw driver and wrench, designed not only to enhance its utility in its legitimate function of driving screws, but also to enable the implement to be used, when desired, as a wrench for turning reamers, taps, and the like.

The driver may be of any ordinary or suitable form, and furnished with the usual and appropriate handle. Provided in the inner portion of this driver, or rather of the blade thereof, are any desired number of holes, these holes being of square, oblong, triangular or other form, to suit the end of the tap or other article for turning which, as by a wrench, the driver is thus fitted. The outer or other portion of this blade of the driver is furnished with an oblong hole or slot, which constitutes a socket for the reception, on occasion, of one end of a supplemental driver, which may be of the forked variety. When the supplemental driver is thus fitted into the blade of the other, first described, the latter constitutes a cross handle for the former, which may then be used with greatly increased power for turning screws, etc. The supplemental driver may, furthermore, be furnished with suitably shaped holes, in the same manner as the inner portion of the

blade of the driver, so that it may be employed by itself as a small and convenient wrench in cases where its use may be applicable.

The Oak and its Products.

Dr. W. A. Weatherbee read a paper on the oak tree and its products, and remarked that no variety of wood will last longer than the oak, citing several problematical wooden relics to prove this point, and thus confound the advocates of red cedar, chestnut, and white pine. The paper was succeeded by a discussion which elicited the somewhat well known items of information that an acid may be obtained by the distillation of different kinds of wood, and that the oaks which grow in California are quite different from those found on the Atlantic coast.

Dr. D. D. Parmelee remarked that wood vinegar is now being made very extensively in this country.

Dr. P. Vanderweyde said there was a large manufactory in Philadelphia in which wood vinegar is made. Acetic acid, obtained from the destructive distillation of wood, is diluted, and forms this vinegar. The bichromate of potash is now much used to take out the flavor and burnt taste of the wood vinegar.

Nitro-Glycerine.

Mr. George M. Mowbray, manufacturer of the nitro-glycerine used at the Hoosic tunnel, gave an account of his experiments with that article. Nitro-glycerine, he said, was first brought into notice as an explosive agent in 1846, on the invention of gun cotton. Nitro-glycerine, as usually made, was constantly giving off a colorless gas in balloon-shaped bubbles; these bubbles are easily made by agitating the nitro-glycerine in the air. He had exploded the fulminate of silver in nitro-glycerine, and the latter was blown out, but not exploded. Many of the faults attributed to nitro-glycerine are due to its being made impure. As we become better acquainted with this article it will become more safe. Some thirty-five pounds of it are used in the Hoosic tunnel every day. Nitro-glycerine freezes at about forty-eight degrees Fahrenheit; and in a frozen state he tried to explode it, but failed to do so. In that condition it is next to impossible; and therefore it is only dangerous in the liquid state. It was also stated that gunpowder and gun cotton might explode in contact with the nitro-glycerine without exploding the latter.

Dr. Vanderweyde remarked that the chloride of nitrogen is one

of the most explosive substances we have. It is made by combining chlorine and ammonia, and drying the precipitate.

A desultory discussion on various explosive materials closed the debate, whereupon the association adjourned for one week.

November 5th, 1868.

Professor S. D. TILLMAN in the Chair; Mr. C. E. EMERY, Secretary.

The chairman opened the proceedings by reading the following notes on science and art:

DYNAMITE.

The London *Mechanics' Magazine* lately gave an account of experiments with dynamite, which is simply a mixture of nitro-glycerine with a finely powdered silicious mineral, showing that it may be handled with impunity, and even exposed to fire without danger; but hearing that the engineers of the Hoosic tunnel did not regard dynamite as any more safe than plain nitro-glycerine, we declined to give further publicity to that account. A late number of the same journal says: "The recent explosion at Pemberton seems to show that dynamite is not so safe an explosive as has been supposed."

SINGULAR EFFECTS OF LIGHTNING.

Gen. Morin reports to the French Academy that in the department of Youne, the lightning set a hamlet on fire. Several cottages were burned; in the drawers of one of them were some gold coins and twenty-five franc silver pieces. The electric force converted the silver in four singularly shaped ingots, but left the gold coin almost unchanged. The gold pieces adhered to each other, and were covered with a slight incrustation, but the effigies on each were still visible.

NEW METHOD OF BLEACHING.

Wild's magneto-electric machine is now being used in a sugar refinery in England for the purpose of bleaching sugar, doubtless to ozonize the air which is used as the bleaching agent. No report has yet been made as to the feasibility of the process.

THE PRISMATIC COLORS.

A correspondent of *The London Builder* says the usual method of observing prismatic colors is by looking at any object through a

prism, or by observing the rays projected by a prism on a surface. Thus all the prismatic colors are displayed at once in small patches, and it is not easy to observe the shades of the prismatic colors, because they are interfered with by the secondaries. Now, by the following method the rays may be, as it were, separated, and only one color seen at a time, that too in large quantity. If, then, instead of looking at the colors through a prism, the prismatic colors be thrown, one at a time, from a prism in the hands of another party, directly into the pupil of the spectator's eye, he sees the whole apartment in one perfect blaze of each color in succession, and the effect is most magnificent, even with a small prism, and when the sunlight is not very strong.

MARINE VELOCIPEDES.

The revival of the velocipede, which was introduced into Europe during the last century, merely as a source of amusement to pedestrians, has prompted a Frenchman to adapt one to be used on water instead of land. It is now on Lake Enghein, twelve miles from Paris, and is described as something like two snow shoes, held about a yard apart by means of iron rods, between which is a propelling wheel, about three feet in diameter, having paddles four inches wide and eight long. It will be seen at once that this is a miniature representation of the famous Burden steamboat, which appeared on the Hudson river more than thirty years ago, and that it bears no resemblance to the land velocipede. The latter adapted to water would be more like an Ohio river steamboat, with a wheel in front as well as behind. Experiments like the above have been repeatedly tried in this country, and it is well settled that human strength is most economically applied to propulsion of a small boat by means of oars.

After the reading of this item, Dr. Van der Weyde remarked that some time since he had seen a marine apparatus which consisted of a cylindrical hollow paddle-wheel, the interior of which was of such size that a man could stand upright therein and roll the thing through the water by treading upon the interior surface, the wheel rotating something after the manner of a treadmill.

A gentleman said that this form was bad in its manner of displacing the water as it advanced. It could not, of course, compete with vessels of the usual form.

Mr. Emery said that Scott Russell had discovered that when canal boats are towed above a certain speed the boats were found to be raised

somewhat in the water, and the proportionate resistance decreased. He (Emery) had seen similar results in small vessels in the navy.

Dr. Van der Weyde corroborated this by saying that the same had been found true in France. It had also been found that by lengthening the boats the relative resistance was decreased.

A member explained that the hulls of vessels are now made so that the portions ordinarily immersed divide the water and force it laterally, while the upper portion of the same is made scow-shaped so as to lift upon the waves. This is true of ocean steamers; river steamers are made with flat bottoms.

SAFETY EXPLOSIVES.

Some time ago Ehrhardt patented several compositions which only became explosive when two of them were thoroughly mixed, but the explosive materials employed seem to have prevented their practical use in the manner proposed. Quite lately Dr. Nisser has done something in the same direction. He prepares two compositions, one containing chlorate of potash and nitre, and the other sulphur woody fiber, and carbon in some cheap form. These powders are non-explosive while apart, but when required for explosive purposes, they are sifted together, and the resulting composition is found by experiment to generate a force about four times as great as that of ordinary blasting powder. It is said a saving in expense, as well as a decrease of danger is secured by the employment of the new preparation.

REVOLVING TURRETS.

The king of Prussia recently inspected the revolving turrets erected on the banks of the Rhine to protect Coblenz against the attacks of gunboats. "It is lamentable," says *The* (British) *Army and Navy Gazette*, "that although England gave birth to the idea, we are at this moment without a single revolving turret in position on shore. What are our royal engineers doing? Echo answers that they are conducting experiments at Shoeburyness which have as yet been productive of no practical results to ourselves, while foreigners, eagerly watching all that has taken place, have returned home with valuable ideas gathered therefrom at the expense of the British nation, and have erected works, and prepared for all emergencies, while we, who are preëminently the iron manufacturing nation, have been discussing plans and producing—Gibraltar shields." The *Gazette* is mistaken as to the origin of the revolving iron turret. It was first brought out and patented many years ago by Timby, an American inventor.

Mr. Emery said that it had been lately suggested to place revolving forts upon water, so that their easy rotation might be assured; to which Dr. Rich replied that a model of precisely this character had been for many years in possession of the American Institute.

Rollers for Calico Printing.

The Swiss calico printers save much of the cost of copper rollers by substituting iron rollers, which are coated with copper of sufficient thickness to receive the engraved pattern. When the pattern is worn out or no longer fashionable, all the roller, except the engraved part, is covered with an insulating varnish. On being immersed in an electrotype bath, all the exposed portions are soon filled up with copper, and the roller is then ready to receive a new pattern. The Swiss process for coating iron rollers with copper is still a secret. Weiskopt has just devised the following: First brush the iron roller with a solution of one part of nitrate of copper in fifty parts of hydrochloric acid. Then with a solution of ten parts of nitrate of copper, ten of chloride of copper, and eighty of hydrochloric acid, applied quickly with a soft brush. After being rinsed and wiped with a soft cloth, the second solution is again applied, and so on until a sufficient thickness of copper has been deposited. The process is cheap, and copper is not apt to peel off if the solutions are applied very quickly.

Electrical Piano.

A musical instrument, more remarkable for its ingenious mechanism than for its cheapness and availability, has been brought out by M. Speiss, of Sumiswald, Switzerland. By means of clock-work, two rollers are set in motion, which carry from one to the other a band of strong paper, containing perforations like that used in a Jacquard loom, and passing over an intermediate brass roller put in connection with the wires of an electric battery, which are arranged in coils around soft iron rods, and become magnets whenever the current of electricity is unbroken. The current is closed by means of a series of pins touching the brass roller, and is broken when the paper passes between them and the roller. Thus a series of iron fingers, by being magnetized and demagnetized, are made to strike the keys to a series of strings with astonishing rapidity. Besides the power which moves the clock-work, a battery of thirty-six Daniel's elements is required to operate this automatic instrument. The greatest difficulty to be encountered is in giving the dynamic effect from which

results accent and expression, since it is impossible to graduate the force of these magnets. Pianists will never be supplanted by any such self-moving device.

THE TERRACE FURNACE.

This furnace, the invention of Gastenhoffer, of Germany, has been successfully used for several years at Swanzea, Wales, and lately in Colorado, for burning the sulphur in copper and iron pyrites. It consists of a hollow vertical shaft, about twenty feet high, with an area four feet by two inside, which contains a number of triangular bars, made of fire-clay, about four inches wide and four inches apart, so arranged as to form a series of horizontal shelves alternately in the same vertical line, and extending nearly to the bottom. Below is a temporary fire-grate on which fuel is at first used to heat the fire-clay shelves and the whole inside of the furnace. When this has been accomplished the grate is withdrawn, and a stream of powdered pyrites, containing at least sixteen per cent of sulphur, is then poured in at the top of the furnace, and allowed to drop down from one shelf to another; at the same time just air enough is admitted at the bottom to furnish oxygen to the burning sulphur. The combustion of the sulphur produces heat enough to make the process continuous. The gaseous products, principally sulphurous acid gas, are carried off into a leaden chamber, where by the ordinary method, sulphuric acid is produced. One furnace at Swanzea ran sixteen months without intermission; and it is evident that, without interruption from breakage or disarrangement of parts, the process may be carried on indefinitely. This furnace is admirably adapted to the manufacture of sulphuric acid, but it is not so valuable for the simple purification of the metals in pyrites, because the high heat required for the complete abstraction of the sulphur melts the pyrites too rapidly, and results in what is technically called "gumming up," which prevents the powder from passing down the various shelves.

THE GOLD REGION OF NOVA SCOTIA.

Dr. T. Sterry Hunt, in an official report lately printed by order of the House of Commons of Canada, describes the geological formation of the auriferous fields of Nova Scotia, and the manner in which gold has been obtained, from which we collect the following information. The coast district of Nova Scotia, which has become famous for its gold, consists of a zone of ancient stratified rocks lying exposed

between the overlying strata of the carboniferous system on the northwest and the ocean on the southeast, and having a breadth of from thirty to fifty miles in the wider portions, which, to the northeast, is reduced to not over eight miles. This belt of rocks extends along the Atlantic coast for 250 miles from Cape Sable on the west, to Cape Canseau on the east. Its surface is generally low, rising, however, in some places to 500 feet above the sea, and is in great part rocky and barren. The official returns from this region for the last six years, based on the gold from which the royalty of three per cent has been paid, show a total production of 119,541½ ounces, which, valued at twenty dollars per ounce, amounts to $2,390,081. If to this be added the unreported gold, obtained in the first two or three years, we may conclude that the whole product has been equal, in round numbers, to about $2,500,000. This amount is small when compared with the production of regions like California and Australia, where the yield of some single mines surpasses the whole annual production of Nova Scotia. The quartz mines of Victoria, in 1866, employed 14,878 miners, and yielded 521,000 ounces of gold. The mean yield to the ton of quartz was, however, only ten pennyweights sixteen grains, and the produce for each miner about $570, while for Nova Scotia these amounts were respectively seventeen pennyweights twenty-three grains, and $765. The produce for each miner is proportionate, not so much to the richness of the quartz as to the skill and economy of the management, which, within the last year, has raised the annual yield per man in Renfew to $895, and in Sherbrooke to $1,592. It may, however, be affirmed that the average yield of gold to the ton of rock, and also to each miner, is greater in Nova Scotia than in any other auriferous region known. It may well excite surprise that so little mining has yet been done in Nova Scotia, where gold is known to be spread over an area of not less than 6,000 square miles. The lodes of this region, which are very regular in structure, have been shown to preserve their richness to depths of 200 and 300 feet, and from their geological relations there is every reason to believe will continue unchanged to the greatest attainable depths. To this it may be added that the price of labor is moderate, not exceeding one dollar and twenty-five cents a day in gold, fuel cheap and abundant; the region is healthful and easily accessible from abroad.

Regulating the Speed of Steam Engines.

Mr. C. E. Emery gave a description of the method of regulating the speed of engines by the usual governor. The pressure of steam in the cylinder gives no indication of the power of the engine at the time. Super-heating steam is a loss, because it entails disadvantage at the end of the stroke. Very late experiments go to show that the "indicator," is an entirely useless article. The experiments were so perfect that there was not a cubic foot of water from the condensed steam to be collected in six hours. The power was measured by a blower. The economy of steam engines vary with every pressure. In experiments with the steam engine, much attention should be given to the mechanical arrangements. The trials spoken of went to show that the best way to regulate the power of an engine is by the "cut off." In his opinion, no engine should be worked with a higher pressure of steam than one hundred pounds.

Mr. T. D. Stetson said that careful experiments were made at the Crystal Palace in this city, in relation to the speed of steam engines. The trials were commenced on June 4th, 1858, and the report of the committee was published in the *London Mechanics' Journal.* He found that all governors were unsteady in their action.

The chairman said the unsteadiness in power described by Mr. Stetson is common to all self-regulating machines which operate quickly. If a steam engine is suddenly relieved of its load, the increased velocity of the piston gives increased centrifugal force to the governor, which instantly moves the cut-off valve, but moves it a little too far; too little steam being admitted, the balls of the governor descend below their normal height and again open the valve, but open it little too wide; the surplus steam again increases speed of the governor; but this oscillation of the revolving balls is less and less until the required velocity of the piston is attained. This oscillating action was beautifully shown by an ingenious invention of the Hon. Elisha Foote, the present commissioner of patents. Many years ago, while still in the practic of the law, he invented a self-regulating stove. His apparatus was applied to the ordinary sheet iron stove for burning wood. The difference in the expansion between a rod of brass and one of iron, placed within and near the top of the stove, was communicated by means of levers to a pendulum on the outside, the end of which moved between two teeth on the damper, to close it and check the combustion, and then passed on until the brass rod began to contract, when the pendulum moved in

an opposite direction and again opened the damper. The pendulum, operating too quickly, produced an alternate closing and opening of the damper until, after a brief period, the pendulum was brought to exactly the right position, and the proper quantity of air was admitted to keep the stove at the required temperature. This apparatus illustrated the condition that will occur in the movement of any very sensitive self-regulating apparatus.

After further discussion of this subject the association adjourned.

November 12, 1868.

Professor S. D. TILLMAN, Chairman; Mr. C. E. EMERY, Secretary.

The meeting was opened by the chairman, who read a number of scientific items, which have been misplaced, and cannot be obtained for this report of this meeting.

RAILWAY TRACKS.

Mr. J. H. Jenkins exhibited two models of his improved form of rails, and presented the following paper, describing their advantages, which was read by T. D. Stetson, Esq.:

"These models illustrate improved methods of constructing railway tracks for steam travel. In one we represent the treatment of the T rail now in common use. Instead of the rails being set singly, and alone bridging from tie to tie, there are introduced on either side of the same, continuous lines of chairs or brackets. These are made of wrought iron or steel, and of the same length as the rails, and are rolled with a groove to fit the sides of the lower half, or webb, of the same. Fitting the outlines of the rail by curves and angles, they set underneath in order to give a uniform support thereto, and, in the aggregate, yield as much, or more bearing surface to the tie as equals the original breadth of the webb of the rail.

Close by the edges of the brackets, and setting upon the faces of the ties, are placed strong "knees" or "dogs," made of cast or wrought iron. These keep the brackets well up to the webb of the rails, and, by overcapping them sufficiently, bind the whole structure firmly and securely to the ties by means of strong bolt screws. These screws are made expressly for the purpose. In the outer half of the dogs, the part which sets upon the face of the tie, an oblong hole or "slot" is made to receive the screw. The screws pass through the knees or dogs and are so constructed—having a coarse, sharp thread, and being

gimlet-pointed, and also milled out on three sides in the manner of a steel "tap" for cutting threads in metals—as to be readily forced to their place in the hardest timber, and through the hardest knots without the labor and time of boring holes.

The process of using these screws is readily accomplished by giving to the screws a large, square head, and having a "key," fashioned precisely like a common boring auger; but, instead of the spur and twist, there is, upon the lower end of the shank, a strong steel bulb, having a square socket, which easily fits the head of the screw. Now, the screw being set to its place, and partially started by giving it one or two blows with a heavy hammer, the auger key completes the operation; for, by means of its levers, the screw is turned down to its holding position in the same time and as easily as to bore similar holes for spikes or common bolts.

By the introduction of these continuous lines of chairs or brackets, we have a uniform combination rail, and are enabled to dispense with all kinds of small plates, chairs and fish-bars at the points of the rails; and, by breaking the joints of the brackets with themselves, and also with those of the rails, distributing all the points of all the parts regularly and equally, we obtain the utmost uniformity of strength and security, and guard the rail proper thoroughly and completely against displacement in case of breakage; for, if a rail become broken in any number of places, unless the line of breakage chance to take a horizontal direction above the bracket, and the piece be thrown out, a train of cars may pass over it as safely as if it were entirely whole, a break in a perpendicular direction always being quite harmless; becoming simply an additional joint.

By this arrangement, we also gain another very important advantage; the ends of the rails and brackets do not require to be secured by passing spikes or bolts through holes or notches made therein, being held to their place entirely by clamping with the dogs; thus allowing sufficient freedom for expansion and contraction by extreme changes of temperature, dispensing with holes and notches in both rails and brackets, giving complete uniformity of strength and stability.

In the second model, we show an improved form of rail, one having the general form of a cone, the base of which is divided by the introduction of a central arch; whereby the bearing is shared by two equal branches, and all the material and strength of the rail secured to the crown and outer sides.

This rail is also set in brackets, fitting on either side and setting underneath, the branches of the base setting upon the brackets by such angles of their lower edges as to make the whole structure self-binding or self-locking. As in the case of the T rail, the joints are regularly distributed throughout the structure, the brackets forming a continuous bridge from tie to tie, and no one tie being allowed to have more than one joint.

A prominent and favorable feature of this form of rail is the perpendicular depth given to the brackets, yielding corresponding bracing and supporting strength of base and sides.

The rail is literally a combination tripple rail; its strength and security being greater than that of any other form with a given quality and quantity of materials.

In this case, also, the brackets are secured to the ties by means of stout knees or dogs made of wrought or cast iron, their faces being placed at an obtuse angle to correspond with that formed by the face of the tie and the side of the bracket. The holes in the dogs being made oblong in the line of their bearing, admits of keeping them close upon the brackets without withdrawing the bolt screws, which are the same as those used in the case of the T rail, being put to the work in the same manner and with the same facility.

In this arrangement, also, we dispense with small plates, chairs and fish bars; simply forming continuous lines of rails and brackets, and avoid the necessity of special fitting at local points, rails and brackets alternately overlapping each the other's joints.

In prosecuting this system of construction, the ties being set, the rails and brackets laid in line of position, the process of placing the dogs or knees, and of setting the screws and turning them to their place, becomes simple and straightforward work.

The grand advantage of the cone and arch form of rail will be found in the latitude afforded for variety and choice of material for construction, while the side brackets must, as a matter of course, be made of steel or wrought iron; the central rail may be wrought of any material which under the conditions may possibly answer the purpose, the margin being bounded by steel, wrought iron, simple cast iron, and cast chilled iron.

This form of rail has also the advantage of bringing all the metal where it is most needed to give the utmost strength for long continued wear. In fact, it is that form which, the more it is worn by use, the better it may become, provided the metal be good and rea-

sonably sufficient in quantity. As no probable amount of pressure could destroy it by crushing, the mere waste by friction and corrosion become the only considerations concerning its durability.

It is believed, by the projector of these methods of constructing railway tracks, that they are the simplest and strongest which can well be devised and rendered practicable; that they embrace all essential principles favoring improvements, and that, taking into account the aggregate cost of all materials for building a road, the time of doing the work, and the expense of keeping all the parts in good repair after completion, they will be found to be the cheapest, the most mechanical and the most economical; over and above all of which are the paramount considerations of safety for rolling stock, for property in transit, and for animal and human life.

The subject of rails for railways occupied the attention of the meeting after the reading of this paper; and at the conclusion of the discussion, Professor R. P. Stevens, who had just returned from the region of the Oronoco, South America, was introduced to the meeting, and remarked that he had been requested to give some of his impressions of the tropics. The first and most striking impression is this: That tropical countries are very poor; poor in their soil, and consequently the people are poor. That first impression was more and more confirmed as he examined the country in detail; and the reason why it is so is apparent to any person who has studied the geological characteristics of the soil. He ventured to say that, taking one year with another, the crop of the western portion of our country is more profitable than the richest sugar crop of the East Indies. The crops, however, vary every other year. Our western country is far richer, in vegetation, than the tropics. We have erected a mill in the valley of Yurana, and our head lumberman, who was from the State of Maine, thought that, within a range of one hundred miles we would not have enough timber to last us one year. In Indiana he had seen timber enough to last a mill there for many years. The forests are so impenetrable that one cannot step one foot out of the beaten path, but the growth of vegetation cannot compare with our country. In the month of June we have a higher growth than any other.

Professor Stevens continued his remarks until the hour for closing, when the association adjourned for one week.

November 19, 1868.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

Fire-Proof Work.

Mr. William A. Berkey, of Grand Rapids, Michigan, exhibited a model of his plan for constructing fire-proof buildings. The main feature of this invention consists in coating the beams, laths and other woodwork with mortar of sufficient thickness to make it impervious to fire. A building twenty feet wide and two hundred deep would cost from $250 to $400 a floor. The mortar passes all around the beam, so that the shrinkage of the wood is not of much consequence.

New Kerosene Lamp.

Mr. John Russell exhibited and explained a new kerosene burner. This burner, he said, is so simple that it cannot get out of order, and admitting, as it does, the free access of air and light below the point of burning, the combustion is perfect, and explosion impossible; while the absence of the usual brass obstructions in the chimney allows the light to shine down as well as up, thus giving double the light from the same quantity of oil, and giving it where it is most needed. The chimney goes on without spring or screw.

New Horse Hay Rake.

Mr. Charles N. Goss exhibited a model of a wheeled horse hay rake, in which the rake, arranged in front of the axle, consists in a series of curved wooden teeth, each tooth attached by a spring joint to a separate carrying bar, and the whole lifted, when desired to drop the accumulated hay, by means of a lever frame arranged in suitable position in front of the driver's seat.

Earthquakes.

The discussion on this subject was opened by Dr. J. J. Edwards, who occupied the greater part of an hour in attempting to prove that the principal cause of earthquakes was electricity. He spoke at length on the correlation of forces, the structure of ærolites, and the internal condition of the earth, quoting from various authors to support his position.

At the conclusion of the paper, Dr. Parmelee gave an explanation of the rupture which sometimes occurs in Leyden jars by the dis-

charge of the electricity through some thinner portion of the glass. He did not consider a comparison made by Dr. Edwards between the condition of a charged Leyden jar and the earth as very *apropos.*

Dr. Vandermeyde said: When we consider that our earth is covered with water for three-quarters of its surface; and that rain is falling nearly all the time, which keeps the ground moist; and the law that we observe in mines that the temperature increases with the depth, and we know that heat will convert water into steam, and when this water penetrates through crevices and there converted into steam, we know a vent will be found, and a shock or an eruption will ensue. The interior of the earth being liquid, and the exterior of unequal thickness, a rupture will take place at the weakest part. The crust may be one mile, or one hundred miles in thickness. It has been observed that after a rainy season there is more probability of earthquakes and mountain eruptions.

The discussion was continued until a late hour, when it was announced that, as the next Thursday was set apart officially as a day of thanksgiving, the association was to stand adjourned to December 3d.

December 3, 1868.

Professor S. D. TILLMAN in the chair; Mr. C. E. EMERY, Secretary.

SELF-RECORDING STEAM INDICATOR.

Mr. Clark exhibited Clark & Edson's apparatus for recording the pressure of steam in the boiler of a steam engine; also the diagrams made by it. He stated that by its peculiar construction the following advantages are obtained:

1st. It records continuously the actual condition of, and every variation in, the pressure of steam upon a card or chart, which can be preserved for future reference.

2d. It records the actual time upon the chart from which the revolutions of the engine may be calculated whenever desired.

3d. It being of a superior construction it is reliable as a *test guage.*

4th. By placing the instrument in the office a proprietor or superintendent can at all times know the actual condition of affairs.

These indicators are applicable to locomotive, marine and stationary boilers. We shall be happy to show an instrument in operation at our office.

The chairman spoke strongly in favor of this apparatus; he thought there was no objections to placing all possible safeguards around the boiler, and that the owners of boilers should have in their possession the evidence as to the pressure in the boiler during the whole work of the engine, which these diagrams will furnish.

Mr. Normon Wiard said he had never seen a boiler that exploded which was stretched in the weakest part. He had invariably found boilers to burst in the strongest part. He had been riding on locomotives for the last nine months.

Mr. C. E. Emery remarked that this system of recording the operation of an engine was used by Mr. Allen in the Collins steamers when they first started. What is much wanted is a machine that will measure the duty of an engine constantly.

Death of Dr. W. Rowell.

Dr. D. D. Parmelee offered a resolution in relation to the death of Dr. Warren Rowell, an active member of the Polytechnic Association.

The resolution was seconded by Dr. Feuchtwanger, who said that Dr. Rowell was a man of no ordinary talents as an inventor. In his own profession he succeeded in restoring speech to a lady who had lost her palate, by making a gold one.

After some remarks from the chairman on the character and worth of the deceased, the resolution was carried unanimously.

The following paper was then read:

PLUMBAGO.

Dr. Lewis Feuchtwanger.—Among the most refractory substances in nature is the mineral plumbago, which is called black lead, graphite, and carburet of iron. Its name, plumbago, is derived from the Latin "*plumbum ago*," meaning, "I act like lead;" as metallic lead was, up to the fifteenth century, used for drawing on paper; the name black lead has the same origin; graphite is from a Greek word, meaning "I write;" the name carburet of iron is more appropriate, as the mineral consists of ninety odd per cent of carbon and a fair per cent of iron. The Brazilian plumbago, however, is pure carbon. All the names just mentioned are used in daily life.

It is quite soft, has a specific gravity of 2.09, a metallic lustre, a shining streak, and an iron-black to steel-gray color. It is opaque, soils paper and feels greasy. When of laminated structure, its laminæ are flexible; but it also occurs massive and granular. Its regular crystal form is a rhombohedron, but hexagonal tabular crystals are

also found. It burns at a high temperature, without flame or smoke; is infusible before the blow-pipe, and not affected by acids. Its geological position is in the primary rocks or altered rocks lying at the base of the palæozoic series. It is mostly disseminated in calcareous or argillaceous shales. Extensive formations of plumbago occur in the Laurentian series of rocks in the northern part of the State of New York, near the head of Lake Champlain, at Ticonderoga, Lake George, and in the range across the lake, in Canada West; in the metamorphic region of Massachusetts, at Sturbridge. In the gneiss of North Carolina there is an extensive formation; large blocks have been quarried from this locality a few years ago. England boasts of the first known and best locality, at Borrowdale, in Cumberland, discovered in the year 1564, during the reign of Queen Elizabeth. It is found there in a greenstone rock, in nests and beds of clay. From the date of this discovery, a new epoch in the industrial operations of domestic economy was opened; and its importance was manifested by the mandate of the English government prohibiting the exportation of graphite. In Bavaria, Germany, and Bolivia, large deposits have been worked. Ceylon has furnished immense quantities of the best laminated graphite. In addition to those above mentioned, the United States furnishes many localities, among which we may mention Morristown, N. J., Concord, N. H., Brandon, Vt., Amity and Hillsboro, N. Y. An extensive deposit has been lately discovered near Saco, Me. California has exported 1,000 tons of superior graphite. Greenland, Spain, Mexico, Norway and Siberia have of late years supplied the world with excellent material. Canada has furnished beautiful specimens of laminated graphite from Burgess and Grenville, and much of it has been disposed of in this market. Other localities could be mentioned where plumbago has, from time to time, been obtained in greater or less abundance. New York, Ceylon, Siberia, and Bavaria are, however, the main sources of supply.

APPLICATIONS OF GRAPHITE.

1. The lead pencil, made from the best quality of graphite, has contributed more to the spread of the arts and sciences in modern times than any other article that can be mentioned among the contrivances in daily use.

2. The black lead crucible is of immense benefit to the brass-founder, assayer, and steel manufacturer.

3. Graphite is valuable as a lubricator, to prevent friction in machinery, the journals of engines, etc.

4. To impart lustre to iron, especially for stoves.

5. In the process of electrotyping or depositing metals by galvanism, this material is useful to coat the wax of the moulds, and render it a conductor of the electric current.

6. In the manufacture of green glass wine bottles, called hock bottles.

7. In the manufacture of gunpowder, for glazing the grains.

8. For "facing" in iron founderies.

9. For lubricating the action in piano-fortes.

These are the principal uses made of plumbago in the arts.

It is well known that the first traces of drawings in lead are contemporaneous with the earliest development of modern art. Mention is made in the fourteenth and fifteen centuries of the use by masters of a pencil-like instrument, on paper surfaced with chalk. This was called the silver drawing. Later, smooth boards, covered with a preparation of calcined bone-dust, were employed in place of chalked paper. The Italians made a pencil of metallic, lead, and tin, which they called a *stile*, and with that instrument "Petrarch's Laura," a portrait from life, is known to have been executed; while Michael Angelo is said to have made use of the instrument in the sixteenth century. Vasari speaks of the advantages that artist derived from the stile, the quill, and both black and red chalk.

The discovery of the Borrowdale mine, in Cumberland, dispelled all other contrivances for writing, and the manufacture of lead pencils became quite universal. The mineral, as it came from the mine, was sawed into thin slabs, and these again into long strips of the requisite size, which were, without further preparation, glued into the wood. These pencils are not surpassed in delicacy or smoothness, and to this day are made in the same manner as they were 300 years ago. The black lead mine at Borrowdale had a yearly revenue of £40,000, sterling, from the monthly public sales. The mine was only allowed to be open six weeks in a year, that the market might not be overstocked. This great mine is now exhausted, and nothing but impure refuse is obtained from that celebrated locality. English manufacturers and men of science have been searching for new supplies, but the discoveries in Spain, Ceylon, Greenland, California, France, Italy, Canada, and the Atlantic States, made from time to time, have not yet produced a complete substitute for the Borrow-

dale mineral. Long before the final exhaustion of that mine, processes were invented for cleaning and refining the impure refuse which had been cast away, and improving coarser and less valuable minerals by its use.

In this way, although the Borrowdale lead could not be had in its palmy days for less than ten dollars, gold, per pound, many manufacturers could obtain fair material for ten cents per pound. It was, therefore, well worth while to excite the ingenuity of men of science to discover either some equally valuable mines, or, in default thereof, a process whereby the foreign matter could be separated from inferior graphite, and an absolutely pure product obtained in every respect fit for pencils and crucibles.

It is, however, a remarkable fact that the Borrowdale graphite owed its fine quality rather to its peculiar state of aggregation than to its purity, as it was ascertained to contain more foreign matter than Ceylon and Canadian graphites. The attempts to refine and clear the impure graphite were carried on by the English mechanics, Brodie and Brockedon, who contrived methods of overcoming the difficulties of the case. Brockedon was long occupied to render the powdered graphite coherent, by submitting it to enormous pressure, and in 1851 I had occasion to examine his whole apparatus in the London Exhibition. It operated in vacuo, and the difficulty of introducing apparatus under the receiver of an air-pump was avoided by an arrangement of simple character. The powdered graphite was compacted by moderate pressure, and inclosed in very thin paper, which was glued over the whole surface, except a small hole for the air to escape from within. The block thus prepared was placed under an exhausting receiver, the air removed, and the orifice closed with a small piece of paper; and in this state it was left for twenty-four hours. It was then submitted to a regulated pressure once more; the different particles became agglomerated, and a black graphite was produced as solid as the natural mineral. I examined the specimens exhibited by Mr. Brockedon in the exhibition. They consisted of various graphites from Cumberland, East Indies, Greenland, Spain, Bohemia, and many other localities; compressed powdered graphite; powdered graphite prepared in a block, by the process mentioned, and the graphite in small solid cylinders, for Mooday's pencil cases and other drawing pencils.

Many other methods were devised, by adding various ingredients, intended to be combined with the powdered graphite, without

detracting from its writing qualities; glue, isinglass, gum arabic, and other gums were applied in vain; metallic antimony succeeded but partially; sulphur came nearest to perfection, but produced too brittle a compound, and the marks made with it remained faint.

In 1795, an important discovery was made in France, which proved a great success, and has become the basis of the present manufacture of pencils. It was the admixture of fine clay with the purified graphite; it not only restored to the graphite the necessary consistency, without materially diminishing its writing qualities, but also any degree of hardness or softness, a resnlt that could not be obtained from the pure Borrowdale. This process is now generally practiced in the following manner:

The graphite is crushed, washed, and floated in large vats, and the clay undergoes the same operation. The floated materials are dried in pans at low temperature, and then mixed together in the requisite proportions. The combined substances are now ground in iron mills as fine as possible, and then kneaded by skillful hands like dough, and put in a cast-iron cylinder, from which it is forced by a severe but low pressure through a small hole at the bottom, through which it passes in the shape of a continuous thread, coiling itself like a rope on a board below. This continuous thread is straightened out into the requisite lengths and laid close together in layers, kept in their places and prevented from warping by a slight pressure. It is then dried at a moderate temperature, and when properly dry, packed in crucibles, hermetically sealed, and submitted to high heat in ovens of a peculiar construction. The graphite is now finished. The most important operation of trying its qualities is now undertaken; and as the entire reputation of the maker of lead pencils depends upon it, it requires a very skillful hand. The approved black lead is now ready for the wood, which is mostly cedar. No other has been found to answer as well. This cedar is imported from Florida; it is cut up in small strips and grooved out, and the lead glued in, and another strip glued over it. The pencil is to all intents and purposes finished, but has to undergo a variety of processes, which change this crude pencil from a rough, square stick, covered with glue, into a smooth, polished, rounded or curved, stamped, gilt, headed, and, in fact, a completed article, which every man, woman or child handles with pleasure and satisfaction, without pausing to consider that a lead pencil has passed through twenty-five hands before it is complete. The ever pointed pencils are made in

the same manner, except putting the graphite into a wood frame. The pencil makers have met with great difficulties in procuring their necessary supplies, and to substitute the exhausted native Cumberland. They were not successful until the year 1846, when a French merchant, John Peter Allibert, discovered in the mountains of Siberia, not far from Jakutsk, an extensive deposit of graphite, which has proved equal to the Borrowdale in every respect. The great pencil maker, Faber, the pioneer of this industry in the world, who has a branch in this city, has possession of this mine, and he received a shipment of 200,000 lbs. by the overland route, via Amoor river, the freight of which amounted to $20,000, of which he is using now 2,000 lbs. per week for his best pencils. The German black lead has been used for a century past in the manufacture of crucibles and for small furnaces for assayers and chemists, while the finest varieties of graphite for pencils have been furnished from Cumberland and Siberia. The Ceylon and German, as likewise the Ticonderoga graphite, furnish the sole material for crucibles. All other localities yield materials for lustres, lubricators and other purposes. Argillaceous matters are not prejudicial to the manufacture of crucibles; but the presence of carbonate of lime is very objectionable, since the lime forms a fusible compound at the great heat to which the crucibles are exposed, and the object is defeated.

The German Bavarian crucibles, which stood in high estimation for centuries past, are composed of very impure materials, not half of their constituents containing black lead; while the American crucible, first introduced in the United States by that pioneer, Joseph Dixon, contains nearly three parts of black lead and one part clay. He began manufacturing the black lead crucibles in 1837, and drove the triangular pots out of this market. This firm consumes at the present day more plumbago than any other one concern in the world. Their crucibles are now introduced all over the civilized world, where the precious metals, steel, or alloys, as brass, German silver, are made or melted. They consume forty tons of it per week; they procure their supplies principally from Ceylon and from Ticonderoga, in New York. The consumption of crucibles for pyro-chemical operations is very considerable; I saw last year, in Pittsburg, in one establishment, 200 large black lead crucibles, in the furnaces at the same time; considering the number of ten or twelve crucible manufactories in the United States, the amount of plumbago consumed in the country cannot be less than 10,000 tons per annum. This quantity of graph-

ite is not used up for the manufacture of crucibles alone; a very large amount is wanted for the lustre, so-called British or Mexican lustre, which froms a very considerable branch of industry; there are no less than fifty manufacturers of lustre in the United States, of which Dixon & Co. put up 150 gross, or 20,000 packages of the lustre per day. Large establishments exist in Philadelphia, Boston, Cleveland, and in this city, so that we may compute the amount manufactured in the United States at 1,000 gross per day.

In conclusion, a few remarks on the great American locality of graphite, situated at Ticonderoga, may give an idea of the extent to which this branch of industry is now carried on. The mining property of the American Graphite Company is comprised in the Arthur and Joes mountains, at Ticonderoga, on Lake Champlain, and at Warrensburgh, on Lake George; the latter contains veins of the granular or compact graphite, which, after having been purified, furnishes excellent pencil lead, while the Ticonderoga mines have only the foliated graphite, containing disseminated carbonate of lime, which requires to be concentrated by proper machinery. This is done in the most practical manner, so that from five to ten tons per day are forwarded ready for crucible makers.

Not less than 150 veins or deposits have already been discovered; some of them have been worked to the depth of several hundred feet; parallel veins are constantly discovered at a distance of twelve feet.

The company prepares the graphite for all the uses known, from stove polish, to the finest lubricator for journals of engines, pencil and crucible lead.

The following paper was then presented:

Tempering Steel.

Mr. Norman Wiard.—If we take a plate of highly carbonized cast-steel one-hundredth of an inch in thickness (the thinner the better), heat it between two cast-iron plates (which will prevent it from being decarbonized), and let it slip, when hot, from between them, edgewise into cold water, it will be made hard enough to cut glass. A plate of steel, one inch thick, so treated, although no heavier than before, will be slightly larger; if it were smaller its hardness might be attributed to condensation. If its surface be rubbed bright and it is slightly and slowly heated, it will soon assume a straw color, which indicates a certain degree of reduced hardness known to the expert.

If the slow heating is continued it next becomes purple, after which blue and last black.

Professor Henry, of the Smithsonian institute, informed the writer a few years since, that these colors indicated the thickness of the scale or film of oxyd upon the surface; and that the blue surface might be removed by careful polishing, so as to expose the purple, and the operation continued would expose the straw color. If, after the black scale forms, which is black oxyd of iron, the same as scales which are found about the blacksmith's anvil, the piece be cooled slowly it will be annealed. The same temperature will produce the same degree of hardness in tempering, whether the scale forms or not. If air should be absolutely excluded no scale would form. If steel be heated too hot, part of the carbon will be vaporized, which, bursting out, will disintegrate the metal; some borax applied will prevent further escape of the carbon, when, by welding and condensation under the hammer it may be partially restored; but it will be *lower* steel and possibly could not be tempered.

High steel, such as is used for tools, to be tempered, has about one and a half per cent of carbon. Low steel, about a half of one per cent of carbon, and is of the quality used for tires for locomotive drivers, &c.; it cannot be tempered by heating and cooling, but may be considerably hardened by condensation under the hammer when nearly cold.

Steel is, or should be, composed only of iron and carbon.

Case-hardening is simply carbonizing or making steel of the surface. Decarbonizing is expending the carbon, and the product, if from cast-steel, is homogeneous iron.

There is no chemical change of quality in steel which is hardened or annealed; hardening is simply the inauguration of tensions by unequal cooling, when conducted in the manner described, and annealing is relieving those tensions, by heating the steel until the tension is relaxed, and then cooling slowly and uniformly.

If the thin plate above referred to could be caught *flying*, as it fell hot from between the cast-iron plates, between two sponges having flat surfaces, well saturated with water, in such a manner as to cool the whole of both surfaces simultaneously, it would not be hardened at all. If the experiment should be conducted with a steel plate half an inch thick, then it would be hardened; because the cooling would not be uniform, the surfaces would be cooled in advance of the middle metal of the mass; steel being comparatively a non-conductor of heat,

it is only possible to cool an extremely thin sheet in this manner with sufficient uniformity not to harden it.

A thin plate of steel, such as described, can be hardened quite as well with the hammer as in water; saw plates are so hardened. A planishing anvil is used, and a smooth-faced hammer, slightly rounded; the steel is condensed and strained by stretching *uniformly*, by which the tensions are inaugurated, giving the quality we call tempering.

I suppose hundreds of mechanics have wondered, as I have, at these mysterious changes in the qualities of steel by the process of hardening, condensation and annealing, and have resorted to books, written by learned men, for information, without finding their thirst for knowledge gratified.

It is difficult (probably impossible in cold water) to temper a large piece of steel without cracking it. When plunged into the water the outside is cooled suddenly and contracted cracks occur, which open slightly at first, but afterward usually close, when the interior metal cools and contracts, when the most dangerous ruptures occur. These last cracks are only seen afterward, when the piece is entirely broken.

A workman was wounded severely in Chicago a few years ago by the explosion of a large steel step for a mill spindle, which he was polishing in a lathe with emery; the heat evolved by the friction expanded the surface, which was already in a state of tension, from the unequal cooling, but not quite ruptured. Heating the outside under such circumstances was like "the feather which broke the camel's back."

In tempering large pieces of steel it is best not to make them harder than required. Do not make them too hot, or have the water too cold, especially if the temper is afterward to be drawn down; cracking the steel may in this manner be sometimes avoided, or the piece may be cooled in oil, which will not cool it so rapidly, and therefore will not cause so severe a tension. When it is practicable, it is a good plan to make the piece hollow, by drilling a hole through it by which the cooling surface will be increased, and greater hardness obtained, while the rupturing tension will be less.

If a flat, square, or round bar, of considerable length, is to be tempered, hold it perpendicular as you insert it into the water; then you will not warp it. If you incline it to a considerable angle, it will have the form of a segment of a circle; the lower side will be longest. The part which cools last is always most reduced in length; if any doubt this, let them try it before they tell anybody of their doubt.

Pieces of irregular form are difficult to temper without warping or cracking; as a rule, insert the thickest part in the water first, or insert the piece into the water in such a manner as to have it cooled in all its parts at the same instant. A wag who was the foreman in a smith shop connected with an establishment in which I was once employed, used to say to his workmen: "The whole art of tempering, so far as it relates to warping the work, consists in putting your piece into the water straight, and taking it out straight!" It is highly important to be able to take it out straight, certainly. Steel should always be heated in a charcoal fire, for any other fuel is likely to contain sulphur, which, if communicated to the steel, injures it; or phosphorus, which is quite as bad. Large masses of steel should be heated with extreme slowness; a large ingot may be cracked in the center by heating it too rapidly on the outside. Ingots from which steel rails are rolled are ruptured in the center by too sudden cooling in the mold, and the defect is perpetuated in the rail. The ingot may be broken by being heated or cooled too rapidly. If the ingot could be cast in a sand mold, instead of an iron one, which withdraws the heat from the surface rapidly, and passed through the rolls before its temperature was reduced, the rail would probably be sound, and a serious accident to a train might thus be avoided. I have no doubt this is the most prolific cause of the accidents which result from broken rails of steel; and the uncertainty which attends fabrications of this kind gives all persons a distrust of a material, which, if properly manipulated, could be relied upon with confidence for the performance of the amount of work expected of it.

Heavy forgings of steel should not be kept under the hammer long at a time, it is better to return it frequently to the fire that there may be no great variation of the heat from the beginning to the end of the work; and when the job is finished cover it up in a bath of slacked lime, which is a good non-conductor, and the slower it cools the better. Thus you may avoid tensions which if not the direct cause of the breaking of the work will materially assist other forces to do it. No strength whatever can possibly be given to fabrications of iron or steel which the immense force arising from unequal expansion may not be sufficient to overcome.

After Mr. Wiard had concluded, Mr. Babcock said that nail machines are made of chilled cast-iron, which seems not to be affected by the hot metal plates from which the nails are cut.

Mr. Wiard stated that this was done on account of the difficulty of

making a large piece of steel; such as is required for the shears of nail machines, could not be made and tempered without cracking. The quality of iron used for gun metal is that which has from three to four per cent of carbon. A piece of brass treated in the same way for tempering steel, becomes softened. This he attributed to the better conducting power of the brass than the steel.

The following paper by H. B. Wilson, Esq., was then read by the author:

Ocean Navigation and Postal Subsidies—The Trans-Atlantic Carrying Trade—How We Lost it and How to Regain it.

Early in the present century our ship builders began to acquire notoriety for their skill in naval architecture. Shortly after the close of the war with England, 1812–14, which was forced on us by the gross interference of that country with our maritime rights, this skill, together with the enterprise of our merchants, led to still more important results in the improvements introduced in the models and accommodations of our ocean ships. The most marked features in these improvements consisted in the gradual increase in size and diminution in their draft. The enlarged dimensions took the direction of length rather than breadth of beam, and the floors of ships, year by year, were made more flat, and were carried further fore and aft. Thus, while an English Indiaman of 800 tons register was only 120 feet long between perpendiculars, an American liner, of the same tonnage, would be 160, and, while the former drew twenty-two feet of water, laden, the latter floated in eighteen or nineteen. Our naval designers also discovered the efficacy of the hollow water, or wave line, in displacing and replacing the water, while European builders continued, for many years longer, to use the convex form of entrance and run in their ships.

From these causes our ships became so superior to those of English build that we acquired almost a monopoly of the best paying passenger and freight business. For twenty years prior to 1840, our lines of packet ships between New York and Liverpool, London and Havre, possessed the same sort of reputation and prestige as that since acquired by the English steam lines. Their size, superior accommodations, and the pleasures of a voyage in these old liners, were the frequent subjects of eulogium and description by the first writers of both countries, and especially by our great novelist, Cooper. Those who desire to learn how much praise was bestowed on these then noble

specimens of naval architecture can turn to "Homeward Bound," and make acquaintance with the fine old specimen of a salt, Captain Truck, and his ship. In point of size and accommodations, the old liners far surpassed the once famed British Indiamen.

By the improvements referred, to our builders had succeeded in reducing the average passage across the Atlantic from about forty to twenty-five days, as compared with the earlier English built vessels. Our fame as ship builders and ocean carriers had now reached its zenith. Nor was it confined to the trans-Atlantic routes named; our merchants were not slow, in those days, in availing themselves of our national superiority on the ocean; they pushed their trade into every part of the world. It was the pride of Americans, wherever they might wander, to behold their country's flag floating from the masts of the noblest ships to be seen.

Such was the superiority of our merchant marine over that of the old nations of Europe, at the period referred to, that we became at once the envy and the admiration of all maritime nations. The ships of war we were compelled to build to defend our rights on the ocean during the war of 1812–14, were found to be more than a match for those of England of equal tonnage, because they were better sailers and easier to be handled. This circumstance gave much uneasiness to our chief rival, England, lest a time might come when we should be able to carry the war to her own shores, if war should come again. This fear led her to build vast numbers of those old monstrosities, the three decker line of battle ships. Of these, there lay over sixty in the Hamoze, behind Plymouth breakwater, when I paid that last resting place for England's old ships a visit, in 1854. If we add those then lying in other ports, the number would be not less than one hundred of these once boasted "wooden walls" lying rotting, the greater portion never having been in commission for service of any kind.

The time, however, was at hand when a new element was to enter into the contest for maritime supremacy. Steam, as a means of propulsion had become a success on our lakes and rivers and in the coasting and channel trade of England. This mighty agent and revolutionizer, being destined to supersede the power of the winds, was fast changing the forms of the ships in which it was to be used. We were the first to find out that in order to obtain high speed, it was needful to materially modify the models of our vessels. To carry the engines, boilers and fuel it became necessary to increase their

length and breadth of beam; and in order to obtain light draft to make their floors flat, and to carry them well fore and aft. We were also, as already remarked, the first to discover the efficacy of the hollow water, or wave line in diminishing friction and displacing the water from the ship's track.

These were improvements conceded to us at the time when the English demonstrated the practicability of steam propulsion in the trans-Atlantic carrying trade. It is just thirty years since the occurrence of this most important event. The Sirius, Great Western, and other steamers of about the same class, excited the wonder and admiration of New Yorkers by their symmetry of design and success. Thousands of people came from hundreds of miles to get a sight of these marvels of naval architecture, and they were really fine ships and crossed the ocean within two or three days as quickly as the fleetest steamers of the present day. But in point of size and comfort they were far behind the latter.

At this time our lake and river boats had reached a speed not since surpassed. There were many splendid and seaworthy steamers on Lake Erie, such as the City of Buffalo, which made their twenty English miles an hour, without any over pressure of steam. How, then, has it come to pass that we have allowed ourselves to be distanced on the ocean? How has it happened that our pride has become so humbled that we have abandoned the ocean field to our competitors? It is often alleged by superficial writers that our trans-Atlantic carrying trade was destroyed by rebel cruisers during the civil war. Nothing is more incorrect than such assertions. They are simply false. If true, how is it we have not recovered some share of it during the four years of peace that has since ensued. The truth is, we had lost it before the war began.

To make the subject more clear let us go back to the time when England established a weekly line of steamers across the Atlantic, sustained by a postal contract with the government. This was the turning point in the competition for the trans-Atlantic trade. Our government should then have met the case promptly; nothing, however, was done for ten years longer. Our merchants and ship builders were content to make some improvements in their sailing vessels. They gloried in their fast clippers, and believed in their ability to maintain their position as the carriers of freight and emigrants; and such is the tenacity with which trade continues to follow old accustomed channels of communication, they actually succeeded for sev-

eral years in waging the unequal contest. Meantime the English were left without a rival for the first class passenger traffic, as well as for the more costly and best paying descriptions of freight, requiring rapid transport.

As year by year glided away, there were amongst our merchants men of sufficient forecast to see that a time must come when steamers would entirely supersede sailing ships. Public attention was aroused to the subject, and it was proposed to build steam ships superior to those of the English line. Congress at length yielded, and authorized a mail contract to be made with Mr. Collins and his associates. The terms were liberal and the ships were built; they were larger, and their hotel accommodations more sumptuous than the first Cunarders, and made better time; but they drew too much water; were too high out of the water, and not long enough to be economical; and they cost a great deal too much to build; or, perhaps, to speak more accurately, the stock of the company was too much "watered" ever to be profitable. To sum all up, the ships themselves turned out great failures.

Meantime our rivals were not idle. Before the Collins ships had got fairly on the ocean race course, and prior to the sad accidents that befel two of their number, the English company were engaged in constructing equally fast and comfortable, and better and safer ships. That line had also, by this time, made sad havoc in the best descriptions of the freight traffic. Our merchants could no longer tolerate the delays of sailing vessels. By paying a little more for steam freight they could turn their capital over twice as rapidly, as when they shipped by the best clippers. Congress finally refused to continue the mail contract to a company that had proved a total failure. Thus ended ingloriously, and most injuriously to our interests, the first effort made to regain our rapidly trans-Atlantic carrying trade, by the only means left open to us, namely: By building steamers equally, or superior to those of our rivals.

While England was profiting by the competition of our short lived line of steamers, and was improving the models, engines, and material of her steamships, for she now discarded wood, and commenced to build of iron; our merchants and builders seem to have become paralyzed, and ship building and engineering have remained about stationary. On the other hand, naval architecture has, during the last twenty years, been made the subject of profound investigation in England and France. The ablest scientific men in those

countries have devoted to it their best efforts. The Institution of Civil Engineers first directed special attention to it in their proceedings, and subsequently the Institution of Naval Architects was established for the special object of promoting naval construction. This body is composed of the most distinguished and learned men of the kingdom, who have made naval architecture their study. Men of science, practical ship builders, and eminent navigators, meet in session annually, and discuss for several days all questions relating to this highly important subject; and each annual volume of their transactions forms a valuable contribution to the common stock of knowledge of the art or science of ship building.

I may here mention that the success of this institution has led to the endowment by the British government of a school for the education of naval architects. The public at large has become interested in the subject, and all the scientific and leading daily and weekly journals freely open their columns to well written communications on every conceivable question connected with ships, engines and navigation. All this has England been doing to develop and maintain her maritime superiority, and France has done scarcely less.

It is now time for us to pause and inquire what *we* have meantime been doing to advance our knowledge of the science of naval architecture and improve our commercial marine. It will scarcely be using too strong language to reply, nothing; certainly nothing in comparison with the activity and enterprise of our rivals. What we have been doing has been to remain stationary, which is nearly the same as going back, and to continue to build wooden ships, after all Europe has discarded that material as no longer profitable or feasible. The Pacific mail line is now the only one, except the coasters, which we are able to maintain, and that is supported by a mail subsidy, and protected by our navigation laws against competition. But for these circumstances it would be driven off the ocean like the trans-Atlantic lines. This company continues to build vast, unwieldy, wooden structures, costly to build and costly to operate. Whatever their *actual* cost may be, they are said to be charged to the company at about one million of dollars each. As compared with iron built vessels, they carry about 500 tons extra, and wholly useless weight, at the very highest and most expensive rate of freight, and this on every voyage for life. This is worse than the fate of Sinbad the Sailor, carrying the "old man of the sea" on his shoulders, because the Pacific Mail Company possesses the talisman by which to rid itself of its dead weight, which

its managers are too dull to use. It would, when we consider the aggregate amount of dead freight carried by all the ships of this line, at a high rate of speed, be profitable for their owners to make of their entire fleet a grand bonfire, and replace it by English or French built iron steamers, if the law would permit of their register. But there is no occasion to go to Europe for iron steamers. If Congress would reduce the duty on iron imported for the express purpose of building ships, we can build as cheaply as Europeans.

Such is a brief and, as I conceive, not overdrawn contrast between the condition of naval construction in Europe and America. The representations, that have from time to time been made to Congress, have been received with a deaf ear, and this most important branch of national industry, on which our maritime greatness wholly depends, has been allowed to fall into decay. Foreign lines of steamers, it is said, are annually paid by the post office department for carrying our mails across the Atlantic; money enough, if husbanded and funded, to establish a semi-weekly line of iron steamers, faster and superior to those now enjoying the fruits of our folly and short-sightedness.

A cry has been raised against postal subsidies, and the agents of foreign steam lines help to intensify it by a skillful use of money paid to news-writers; their object, of course, being to defeat American enterprise, and fight off competition. Many members of Congress, whose ideas of national requirements do not rise above county or State policy, use the clap-trap argument that the United States government was not formed to develop public enterprise by national grants. If such were true, in fact, the sooner we can reform it the better. But nothing is more unfounded than such assertions. The federal government was expressly formed to meet the national demands in this and numerous kindred subjects. What is the difference between contracting with a railway company, or the owners of lake, river and sound boats, or of stage coaches, or wagons to carry the mails, over all the country, and with the owners of ocean steam ships? The Constitution of the United States expressly provides for this kind of service, and nothing but the most narrow, bigoted and local or sectional view of national duties, stands in the way of turning this provision to a very important account, in re-establishing our ocean commerce. In the estimation of these village statesmen the term "postal subsidy" seems to have acquired an odious meaning. Such men have taught the public to regard a postal subsidy as a gift from the public treasury to a company of "bloated capital-

ists," instead of its being the payment of an equitable sum of money for services rendered the nation.

Congress seems to have taken the same inconsiderate and most injurious view of the subject, and allows our enormous European mail matter to be given, and paid for most amply, to foreign steam companies. Suppose we drop the term subsidy and call it a contract for carrying the mails to and from Europe. We shall thus get rid of the unpopularity attaching to a name. Such a contract exists between the British government and the Cunard British and American Royal Mail Steamship Company, and it has been shown that the money paid by the British post office department, is more than repaid by the postage on the mail matter carried by the company.

But if Congress shall reconsider its decisions on this subject it should be careful to provide that we shall have no more wooden vessels built for the carriage of the ocean mails. The committees having charge of this matter should inform themselves on the subject of naval construction, sufficiently to specify in the law the size, draft and other conditions indispensable to high speed and economy, so as to prevent a repetition of past blunders. It can be demonstrated to the satisfaction of any unprejudiced and intelligent man, that, with the present knowledge of science, we can build steamers that can cross the Atlantic, in ordinary ocean weather, in seven days. The science of ship building is far ahead of the practice, even in Europe. This is owing to the conservative nature of capital in respect to what is termed "untried theories." But, after the speed our lake steamer acquired twenty years ago, why should we not be able to convince the most careful capitalists that what is proposed is, after all, not "an untried theory," but simply a combination of all the best points in well known steamers and well established principles of engineering. By doing so we shall, by a single bound, distance our competitors on the ocean, as we have shown our ability to do on our lakes.

To do this, we must pay attention to scientific data. Having on a former occasion, before this learned body, entered considerably into details, I do not propose to go over the same ground again, and state the arguments I then adduced. It will now be sufficient for my purpose to state facts. The question for Congress and the country to consider is, how are we to so utilize the money paid foreigners for carrying our ocean mails, as to re-establish us in the position we once held as ocean carriers? I answer, by putting on our "seven

league boots," and just taking one or two steps ahead of those who have distanced us in the race. *Our* seven league boots must be ships of greater length, lighter draft, and finer lines than those of our rivals. These conditions can be effected without any increase in depth of hold; and they will give an important gain in speed, without any addition of engine power; but, as their actual tonnage capacity will exceed that of such ships as the China, Ville de Paris, and others of the same class, by 1,500 to 2,000 tons, I would recommend that half this increase of tonnage shall be used to obtain increased power and speed, and the other half for the carriage of freight, and increased passenger accommodations.

When we have once successfully recommenced ship building on a large scale by the use of iron and steel, we shall be able to hold our own, not only in the transport of mails and first class passengers, but in all other branches of ocean traffic.

If Congress, however, takes a narrow and sectional view of this great national interest, in order to be consistent it should abolish our registry laws and give up the coasting, as well as the trans-Atlantic trade to England and France. Allow our merchants to buy their ships in the markets of the world and thus forever abolish ship building from our shores. I leave this part of the question here, for the consideration of the public, and especially of members of Congress, in order briefly to point out the urgency of action.

In a few months we shall have completed the first great national highway across our continent. This, like the ocean, is destined to become the highway of all nations. The trade of three continents will immediately flow over it and enrich those who may possess the facilities to control it on the two oceans. A single line of rails will soon be found to be unequal to the requirements of this vast foreign and domestic inter-oceanic trade, and two or three other trunk lines will speedily follow. We shall transport the mails between Asia and Europe, from ocean to ocean, and our own letter and other postal business will be increased several fold in half a dozen years more. The time is also at hand when passengers and express freight will be transported between Europe and San Francisco in a fortnight, that is, when we have found out that steamers can be built to cross the Atlantic economically and with unerring certainty in seven or eight days. The journey between China and Japan and Europe will then be performed in about the same time that it now takes to do it between New York and San Francisco, or in less than a month. When that

time arrives, and it is not far distant, our government can afford to pay out of the moneys received on trans-Atlantic postage, enough to insure a semi-weekly line of steamers such as I have described.

Let our statesmen ever bear in mind, the lesson that all history teaches us, that the nations who have made themselves masters of the seas have dictated the policies, and controlled the destinies of the rest of the world. The stake we are bidding for is, therefore, the grandest and the most imposing ever presented to national ambition. We have, more by individual efforts and personal enterprise, than by public policy, acquired a footing and an influence in the great Asiatic empires of China and Japan. It now behooves us, as a nation, to secure to ourselves and our children, by a liberal and a wise policy, that which the genius of our citizens has already partially accomplished. By this kind of policy we have created a grand highway between the ocean that separates us from Europe on the one hand, and that which on the other divides us from Asia. Let us now by the same policy bridge the two oceans with lines of fast and magnificent steam ships. When this is done, will all eyes throughout the whole world be directed to America as the sun from whence emanates light and knowledge, and all that is needed to develop human intellect and enchance human happiness.

At the conclusion of Mr. Wilson's paper the association adjourned.

December 10, 1868.

Professor Samuel D. Tillman in the chair; Mr. C. E. Emery, Secretary.

Propulsion of Vessels.

Mr. F. R. Pike illustrated his method of propelling vessels. He claimed a great advantage in applying power at a certain angle to the propeller or paddle-wheel. The plan excited considerable discussion, which was chiefly unfavorable to the method proposed by Mr. Pike.

Ventilation.

Messrs. Hawley and Phillips exhibited a model of Mr. Henry Ruttan's system of ventilation. The room in which this meeting was held had just been fitted up on this plan, and served to illustrate its working. The cold air was brought into the room from the lower portion of one of the windows, and conducted through a series of pipes heated by steam, when it was allowed to rise and move

along the ceiling, descending as fast as the lowest stratum of air was carried out of the room by means of openings underneath the stage, which were connected with flues reaching beyond the roof of the building. The main idea being, to produce a circulation and change of air, by driving off the coldest portion, and substituting for it warm and fresh air. After the exhibitors had explained their apparatus they submitted for consideration the following paper:

VENTILATION OF DWELLING-HOUSES.

Prof. J. A. Sewall, of Normal University, Normal, Illinois.—Three things are absolutely essential to the physical well-being of man: Air, food, and sleep. Deprive him of either of these and he dies. Air and food are material things, to act and to be acted upon in the economy. Sleep is a *condition* of the nervous system, depending upon the action of air and food. Deprive a man of air and food, and he ceases to sleep; modify the air and food, and sleep is correspondingly modified. If the air be pure, the food good in quality and sufficient in quantity, other things being equal, the sleep will be sweet and refreshing; and if the air be impure, the food unwholesome or insufficient in quantity, the sleep will be imperfect, troubled, and dreamy. If the food be good and sufficient, while the air is impure, the food, though good, will not act or be acted upon properly, and, consequently, will not nourish the body; and if the body is not properly nourished and sustained, sleep is imperfect, does not act as "tired nature's sweet restorer." Then, on the air we breathe depends all that is essential to our physical well-being or health. It is the breath of life.

Experience teaches the same fact. The lumberman of our northern pine forests, in his camp of boughs, his diet of beans and pork, lard and molasses (food that is ordinarily regarded not the most wholesome), whose habits are not altogether the best, is always strong, robust, and most nearly free from all the ills that flesh is heir to. His food is coarse, his work is hard and exhausting, and he is exposed to cold wind and storm; yet his breath in the forest by day, and in the camp by night, is the pure life-giving air of heaven; and, breathing this, his food is well digested, his sleep refreshing, and bare existence is to him a pleasure.

Now, army statistics show that the field hospital is far better for sick and wounded soldiers than the best constructed and best managed post hospitals. Though in the latter, every comfort and con-

venience seem to have been provided, yet pure air, in sufficient quantity, was not supplied; while in the field hospital, though much was lacking, the supply of pure air was abundant.

Again, the statistics of Europe and of the United States, touching this matter, demonstrate most clearly that, other things being equal, outdoor employments are the most healthy, and contribute most to longevity.

I think it needs no argument to demonstrate the proposition, that man was intended by the Creator to breathe pure air.

Therefore, breathing other than pure air is a violation of God's law; and that, for so doing, we must and do suffer the penalty.

There is a vast amount of diseased humanity in the world, as indicated by the number of physicians, and the vast amount of nostrums offering themselves to mitigate the pain, and to cure the ill. But there is no philosopher's stone, no elixir of life, no royal high road to health. Only by regarding the conditions, observing the laws, working in God's appointed way, can we enjoy the blessings of health. And as the breath is most emphatically the life, the character of the fluid we breathe, to a great extent, determines the character of our physical life, whether it be good or evil.

THE PHYSIOLOGY OF RESPIRATION.

It is said that we breathe to purify the blood. But how? Why is it, then, when we wish to preserve, to keep pure air, organized matter, as vegetables or meat, we remove as far as possible, all air, and secure it from its action? If the air will purify the blood, why not meat, or any other organized body? Now, we know that the air, or the positive acting agent, the oxygen, always acts as a destroyer; its sole office is to tear down, to break up all organic compounds, and resolve their elements into simple and more stable groups. Its office and tendency is everywhere the same; and unless this tendency be resisted by some antagonizing force, the oxygen would speedily and completely destroy the whole organized world. Then why does not oxygen destroy the animal? It does, and yet does not. It feeds upon the very tissues of the body, and is fed by them; it demands victims to be sacrificed, to appease its never satiated appetite; and, were it not for that strange and mighty force which we name and recognize, but do not comprehend, vitality, which regulates and controls the action of this agent, it would speedily resolve all organized matter into stable and lifeless forms. Literally, the organized world

would be burned up, and naught left but its ashes; and when vitality ceases to antagonize or resist its action, we return to the dust from which we sprung.

Then breathing is not for the purpose of purifying the blood, but to break down the tissues of the body, and remove them under the direction and control of the vital principle. In all animal tissues there is work performed which has a tendency to wear out and render unfit for service parts of themselves, parts or molecules that have lost their vitality, and these worn out molecules become the food for oxygen. These worn out atoms are for the most part hydrogen and carbon. The oxygen seizes upon them and converts them, by thus uniting with them, into carbonic acid and water; or, using another figure, the oxygen may be regarded as scavenger boats, which enter the lungs, pass into the blood, and are carried into every part of the body, where they are loaded with these worn out elements, carbon and hydrogen. With these loads they return through the veins to the lungs, and pass out into the air in the form of carbonic acid and vapor of water. They are now taken up by the leaves of the trees, unloaded, the carbon and hydrogen entering into and becoming a part of the tree, while the unloaded scavenger boats (oxygen) are returned to the atmosphere to repeat the process. Verily, then, "the leaves are for the healing of the nations." This, then, is the office of respiration, *to remove the worn out tissues of the body.*

Now, if the air is more or less saturated with this carbonic acid, some of these loaded barges, when we inhale a breath of air, will enter too. The demand of the tissues is for vehicles to convey away the waste products, and the demand is imperative; and, though the loaded barges go at the call of the suffering tissues, they cannot remove any of the material, for they are already completely loaded. Two atoms of oxygen can take but one of carbon, and, therefore, they but obstruct and block up the way, and thus produce disorder and disturbance—disease.

Now, there must always be a small amount of carbonic acid in the atmosphere, because it is continually being emitted by the whole animal kingdom, and as a product of combustion and decay. Yet, by the peculiar law of gaseous diffusions, it is so completely diffused through, or mingled with, the atmosphere, that it amounts to only 1-2500 of its weight.

As the specific gravity of carbonic acid is considerably greater than that of the air, were it not for this gaseous diffusion it would settle to

the bottom of the atmospheric ocean and form a layer five feet in depth. But, if only the normal amount be present, it is completely diffused, so that we find it existing in exactly the same proportion on the mountain and in the valley. But, if more than 1-2500 be present, the tendency is to settle at the bottom, making the per cent of carbonic acid greater near the surface than in the higher regions. Thus, in the *Grotto del Cane*, in Italy, where the gas escapes in large quantities from the earth, all animals entering the cave almost instantly die from the effect of breathing the carbonic acid. Now, if the air contain only one or two per cent, its effect is clearly poisonous. If ten per cent, it produces immediate death.

Heat and Ventilation.

We have attempted to demonstrate that pure air is the normal breath of man; but art and civilization have induced conditions which to a greater or less extent interfere with or antagonize the purely normal conditions.

Man finds that it is necessary to his comfort to be sheltered from the heat and rain of the tropics, and from the heat and cold and storms of the temperate and frigid regions. To accomplish this end, he erects the roof and builds the wall about him; in short, he builds a house.

Now, this house is an evidence of high civilization; it adds to his comfort. But by living beneath this roof, within these walls he has, to a certain extent, disregarded the normal conditions, for the air within the confined space is not so pure as that which surrounds it, and, therefore, his respiration is imperfect. Again, in all the regions of the earth north of twenty-five degrees south latitude, and south of twenty-five degrees north latitude, man finds that artificial heat is necessary, and in our latitude is required in our houses for more than half the year. Here, then, is another artificial condition, and one which, to a greater or less extent, interferes with the natural or normal condition. If the fire be made to burn in an open fire place, or in a close stove, a portion of the oxygen of the air is required to oxydize the fuel. Now, if the supply from without be sufficient, both for respiration and combustion, little heat could be imparted to the room; because the supply must be of the same temperature as that of the air outside the house. On the other hand, if we cut off the full supply, the air in the house might be warmed, but would be rendered impure. In short, the air would be as we find it in nearly all our houses—hot, but poisonous. No doubt that either the old

fashioned fire place or the more modern coal grate is the best contrivance for warming. But a strong objection is, as we have stated, the drafts of cold air induced; added to this is the great expense. In fact, the latter objection is so great that these methods have been already entirely abandoned.

Few persons seem to understand just how the air in a room is warmed. It is generally thought that the air in immediate contact with the burning fuel or the heated stove is warmed, and that this warms another, and so on until all the air in the room is warmed. Not so at all. The air next to the burning fuel, in the case of the open fire, is warmed, and, for the most part, goes up the chimney. A small part, however, arises, and the cold air takes its place. The heated air that rose slowly cools, and is displaced by the warmer and rarer air just escaped from immediate contact with the fire, and, after a time, falls, and is again warmed. So that we see only a small part of the air of the room is warmed, while whole oceans are heated and escape from the chimney. If a stove be used for heating, only a small part of the air comes in contact with the burning fuel; in fact, just enough to oxydize the fuel, while the air about it is heated and rarified, and then pressed up by the cooler and heavier air, which is in turn heated and forced up, and thus we have a current of air established, moving towards the stove, then up to and along the ceiling, then down to be warmed again. But as this current takes place in a closed room, and the tighter the better, we think, of course it is the same air, moving in a circle, to which we are constantly imparting the carbonic acid of the breath, which is warmed and circulated and breathed again; and, if our rooms were absolutely air tight, in a short time the air would be so saturated with carbonic acid as to produce death. We shall never be able to tell how much we are indebted to green lumber and indifferent workmen.

Another method of heating is by driving steam through coils of iron pipe. Not only does this method of warming render ventilation impossible, but it is, perhaps, the most uneconomical.

Now, heat may manifest itself in two ways, viz.: As temperature and as expansion. All the force generated by the burning fuel will appear in one of these forms, or a part of both. Water at the normal pressure can be heated to only 212 deg. Fahrenheit. Consume as much fuel as you will, and the water will remain at 212 deg. Fahrenheit. But the force generated by the consuming fuel is not lost, but is transmitted to the water in the form of expansion, and the water is converted

into steam. Now, if the water be confined, this tendency to expansion resisted, the temperature can be elevated to almost any extent; but if not thus resisted, the temperature will not rise above 212 deg. Fahrenheit. As it is necessary to force the steam through the pipes, this expansion must be resisted until sufficient force is accumulated to accomplish this result. Now this mechanical work is performed at the expense of temperature. If a building is warmed by steam, three-fifths of the force generated by the burning fuel is consumed in the form of mechanical motion. The temperature of the steam in the boiler may be 400 deg. or 500 deg. Fahrenheit; but the pipes never indicate a temperature above 212 deg. Fahrenheit. I have never found it above 100 deg. Fahrenheit. On the other hand air may be heated to 600 deg. Fahrenheit, with but slight expansion; so that nearly all the force generated by the burning fuel appears as temperature, while scarcely a particle appears as mechanical motion. Here we see why Ericsson failed in his attempt to use heated air instead of steam as a motive power. Heat being applied to the air, appears as temperature but being applied to water, appears as expansion, or mechanical motion.

Thus we see that in all these plans of heating there can be no adequate ventilation. But as we accustom ourselves to an atmosphere impure and unfit for breathing, and do not feel any direct and immediate effect, we endure it, and think little or nothing of it; yet we wonder why we suffer from headaches and aches of every description, and gravely wonder at a mysterious Providence, when some terrible epidemic of a zymotic character appears, and numbers its victims by thousands.

It may not be necessary here to dwell upon the fact that, by the repeated passage of the same air through the lungs, it may, though originally pure and wholesome, be so strongly impregnated with carbonic acid, and may lose so much of its oxygen as to be rendered utterly unfit for the continued maintenance of the ærating process; so that the individual who continues to respire it, shortly becomes asphyxiated. There are several well known cases in which the speedy death of a number of persons confined together has resulted from the neglect of the most ordinary precautions for supplying them with air. That the "Black Hole of Calcutta," which occurred in 1756, has acquired an unenviable pre-eminence, owing to the very large proportion of the prisoners—123 out of 146—who died during *one night's* confinement in a room eighteen feet square, only pro-

vided with two small windows; and it is remarkable that of the twenty-three who were found alive in the morning, many were subsequently cut off by putrid fever. Such catastrophes have occurred even in this country, from time to time, though usually upon a smaller scale. There has happened one at no distant date, however, which rivaled it in magnitude. On the night of the first of December, 1848, the deck passengers on board the Irish steamer Londonderry were ordered below by the captain, on account of the stormy character of the weather and although they were crowded into a cabin far too small for their accommodation, the hatches were closed down upon them. The consequence of this was that out of 150 individuals, no fewer than seventy were suffocated before the morning.

"It cannot be too strongly impressed upon the medical practitioner, however, and through him upon the public in general, that the continued respiration of an atmosphere charged in a far inferior degree with the exhalations from the lungs and skin, is among the most potent of all the predisposing causes of disease, and especially of those *zymotic* diseases whose propagation seems to depend upon the presence of fermentible matter in the blood. That such is really the fact, will appear from evidence to be presently referred to; and it is not difficult to find a complete and satisfactory explanation of it. For, as even the presence of a small percentage of carbonic acid in the respired air, is sufficient to cause a serious diminution in the amount of carbonic acid thrown off, and of oxygen absorbed, it follows that these oxydating processes which minister to the elimination of effete matter from the system, must be imperfectly performed, and that an accumulation of substances tending to putrescence must take place in the blood. Hence there will probably be a considerable increase in the amount of such matters in the pulmonary and cutaneous exhalation; and the unrenewed air will become charged, not only with carbonic acid, but also with organic matter in a state of decomposition, and will thus favor the accumulation of both these morbific substances in the blood, instead of effecting that constant and complete removal of them, which is one of the chief ends of the respiratory process to accomplish. It has been customary to consider the consequences of imperfect respiration, as being exerted merely in promoting an accumulation of carbonic acid in the system, and in thus depressing the vital powers, and rendering it prone to the attacks of disease. But the deficiency of oxygenation, and the consequent increase of

putrescent matter in the body, must be admitted as at least a concurrent agency; and, when it is borne in mind that the atmosphere in which a number of persons have been confined for some time, becomes actually offensive to the smell in consequence of the accumulation of such exhalations; and that this accumulation exerts precisely the same influence upon the spread of a zymotic disease, as that which is afforded by the diffusion of a sewer atmosphere through the respired air. It scarcely admits of reasonable doubt, that the pernicious effect of over-crowding is exerted yet more through its tendency to promote putresence in the system, than through the obstruction it creates to the due elimination of a carbonic acid from the blood. For, it is to be remembered, that whilst the complete oxydation of the effete matters will carry them off from the lungs, in the form of carbonic acid and water, leaving urea and other highly azotized products to pass off by the kidneys, an imperfect oxydation will only convert them into those peculiarly offensive products which characterize the fæcal excretion.

"Of the remarkable tendency of the respiration of an atmosphere charged with the emanation of the human body to favor the spread of zymotic diseases, a few characteristic examples will be given. All those who have had the widest opportunities of studying the conditions which predispose to the invasion of cholera are agreed that *over-crowding* is amongst the most potent of these; and, from the numerous cases in which this was most evident, contained in the 'Report of the General Board of Health' on the epidemic of 1848–9, the two following may be selected:

"In the autumn of 1849 a sudden and violent outbreak of cholera occurred in the workhouse of the town of Taunton; no case of cholera having previously existed, or subsequently presenting itself, among the inhabitants of the town in general, although diarrhœa was prevalent to a considerable extent. The building was altogether badly constructed, and the ventilation deficient; but this was especially the case with the school-rooms, there being only about sixty-eight cubic feet of air for each girl, and even less for the boys. On November 3d one of the inmates was attacked with the disease. In ten minutes from the time of the seizure the sufferer passed into a state of hopeless collapse. Within the space of forty-eight hours from the first attack forty-two cases and nineteen deaths took place; and, in the course of one week, sixty of the inmates, or nearly twenty-two per cent of the entire number, were carried off; while almost every one of the survivors suf-

fered more or less severely from cholera or diarrhœa. Among the fatal cases were those of twenty-five girls and nine boys, and the comparative immunity of the latter, notwithstanding the yet more limited dimensions of their school-rooms, affords a remarkable confirmation of the general doctrine here advanced; for we learn that, although good and obedient in other respects, they could not be kept from breaking the windows, so that many of them, probably, owed their lives to the better ventilation thus established.

"Now, in the goal of the same town, in which every prisoner is allowed from 819 to 935 cubic feet of air, and this is continually renewed by an efficient system of ventilation, there was not the slightest indication of the epidemic influence.

"The other case to be here cited, is at the Millbank prison, in which the good effects of the diminution of previous overcrowding, were extremely marked. In the month of July, 1849, when the epidemic was becoming general and severe in the metropolis, the number of *male* prisoners was reduced by the transfer of a large proportion of them to Shorncliff barracks, from 1,039 to 402; the number of *female* prisoners, on the other hand, not only underwent no reduction, but was augmented from 120 to 131. Now, the cholera mortality of London generally, which was 0.9 per 1,000 in June and July, *increased* to 4.5 per 1,000 in August and September; and the mortality among the *female* prisoners underwent a similar *increase*, from 8.3 to 53.4 per 1,000. But the mortality among the *male* prisoners exhibited the extraordinary diminution from 23.1 per 1,000, which was the rate during June and July, when the prison was crowded, to 9.9 per 1,000, which was its rate during August and September, after the reduction had taken place. It is scarcely possible to imagine a more *probative* case than this; since it shows, in the first place, the marked influence of the crowded state of the prison upon the fatality of the disease; secondly, the diminution of mortality among the male prisoners, consequent upon the relief of the overcrowding, notwithstanding the quintupling of general mortality of the metropolis during the same period; and thirdly, the yet greater increase of mortality among the female prisoners, which proved that the diminution among the males could not be attributed to any recession of the epidemic influence from the locality."

From the very full and careful statistics prepared by the surgeon-general of the armies of India, I find the mortality from cholera varied as the provision for ventilation varied. Every other circum-

stance and condition being the same, the mortality, where the provision for respiration was good, amounted to fifteen in 1,000; where it was very bad, it amounted to 108.6 in 1,000. Not only, then, does theory teach us that imperfect respiration induces disease, but also these facts, and hundreds of others that might be cited, demonstrate the same truth. True, the effects of bad ventilation may not exhibit themselves in the form of cholera or putrid fever, but they must, and do, manifest themselves in some other way, in slower diseased processes.

With all these facts confronting us, it would seem that science might devise, and philanthropy apply, some means by which, in our homes, in our churches, in our school-houses, in all our public buildings, we could enjoy this necessary luxury of pure air. Various methods have been attempted for the accomplishment of this end; but these attempts have been, till within a few years, perfect failures, and the complaint of poor or no ventilation, almost universal. Yet the principles upon which a perfect system of ventilation is based, are very simple. Two things are necessary: First. Pure air must be supplied in sufficient quantities. Second. The foul or impure air must be removed. It is quite impossible to do one of these without doing the other. You cannot introduce air into a room already filled with air. You cannot remove the air from a room without admitting something to take its place.

The Ruttan System.

These simple principles above referred to are those on which Hon. H. Ruttan's system of warming and ventilation is based. These are the simple conditions observed. Cold air is admitted in abundance to the "air warmer," where it is *warmed* (not heated *red hot*, and its life sustaining qualities vitiated), then rises, and is diffused through the room, or rooms, by means of transoms near the ceiling; while the cold air, being heavier, falls to the floor, and escapes at or near the bottom of the room, passes beneath the floor, and is collected into the foul air shaft, and escapes into the outer air.

Still, it is the almost universal practice to set furnaces, and provide hot air pipes to conduct the heated air *into* a room, and make no provision whatever for the air to get *out* of the room, and, in most cases, no cold air duct is provided to supply air to the furnace; and yet men expect to force a current of hot air from such heaters into a room, and effectually warm it. Let any one *think*, only for a moment, that all

rooms are *always full* of air of some kind, and then remember that it is *just as impossible* to put *two quantities of air into a room at the same time, as it is two quantities of anything else*, and a man would be just as sensible who should try to force twice as many cubic feet of marble into a room as there were cubic feet of space, as he would be who tries to force hot air into a room already full of cold air, without first providing for the cold air to go out. To illustrate: The writer, only a few days ago, was called to visit a large church, designed to seat one thousand people, which, it was said, was arranged for ventilation. And, upon examination, it was arranged to be heated by four furnaces, and it had some eight or ten ventilating shafts or chimneys, expected to exhaust or take the *air out* of the building, *but not one inch of opening was provided to take air in.* But the furnaces were to be set in the basement lecture room, and then take the air from that room and heat it, and send it up into the main audience room and out of doors through the chimneys.

Mr. Ruttan has demonstrated by many experiments, during the last twenty years, and at an expense of over $30,000, that there is no way to get the impure air out of a house except by chimneys or upright shafts, and admitting the air into them at the very bottom. He has perfected a plan to effect this result, which is simple and cheap, and when put into the building as it is being built, costs actually little or nothing more than to build the house the ordinary way without providing for ventilation. His plan is to take the air into one central apartment, usually the hall, through the "air-warmer," and then pass it from it to the adjoining rooms through registers or transoms, at the top of the room, over the doors, and thence downward and out at the bottom through an open base-board, under the floor, and thence into the chimney. By this arrangement we avoid all currents of cold air *over the floor*, as in the case with stoves, and keep the floor always warm, varying only some four or five degrees from the temperature, say *five feet* above the floor; while in any ordinary room, warmed in the ordinary way, the thermometer will show a difference often of thirty degrees.

In a room thus ventilated, the air cannot be impure; because as we have before stated, the carbonic acid exhaled from the lungs, being heavier, falls to the lower part of the room and escapes, while pure air from without takes its place. Here, then, we have a perfect system of ventilation. We secure a complete supply of pure warmed air, but without strong currents being established; while the impure

air flows out continually. Another great advantage gained by this plan is the *equality of the temperature of the air.* Actual experiment shows that there is not more than five degrees Fahrenheit difference between the temperature at the ceiling and at the floor; while in a room warmed by a stove, the difference is from twenty to forty-five degrees Fahrenheit.

This plan of passing the foul air out, at or near the floor, is emphatically new. It is an idea which has completely revolutionized the old systems of ventilation. The purest and warmest air is always at the top of the room; while the coldest and most impure is always at the bottom. If we make an opening at the top of the room, the purest and warmest air will escape; if at the bottom, the coldest and most impure air will escape. It would seem that it is not difficult to determine which of these two plans is the sensible or true one. It scarcely seems necessary to claim more for this system. If pure air is so absolutely essential to physical well-being, and if we can adopt any means, however expensive, to secure it we might rest satisfied. But it is far from being expensive; while on the contrary, a building, whether large or small, can be constructed as cheaply with such provision for ventilation as without it; and can be warmed at much less expense than by any other plan. The cost as compared with that of heating by steam is less than one-third, as I have clearly demonstrated by a series of careful experiments and observations. As compared with ordinary hot air furnaces, not more than one-half. As compared with ordinary stoves, it is decidedly less. In short, this system seems to possess every possible advantage. It is simpler, cheaper, and, best of all, it gives what is so much needed—a full, complete, and constant supply of pure air; and I honestly believe that when this system is generally adopted in our country, the rates of mortality will indicate a marked decrease.

Considerable discussion followed, from which it was apparent that many were of opinion that while the Ruttan system would work admirably in very cold weather it was doubtful whether it could be made to operate well under all changes of temperature.

Adjourned.

December 17, 1868.

Professor S. D. TILLMAN in the chair; Mr. C. E. EMERY, Secretary.

NEW PETROLEUM LAMP.

Mr. John Johnson, of Saco, Maine, exhibited a lamp which he claimed to be non-explosive. The tube in which the wick is held passes to the bottom of the oil; the oil cannot be taken out without putting in an equivalent of air. Any lamp could be made non-explosive if constructed on this principle. This lamp cannot be exploded, as all the air to form an explosion has to pass beneath the liquid or oil. Fire cannot pass through the oil, and the air in an explosive mixture is not saturated with the vapor of the oil.

Dr. D. D. Parmelee said it is the admixture of good petroleum with the cheaper products of petroleum, for which there is no sale, that makes the kerosene lamps so dangerous. If the oil is of the proper standard there is no more fear of a petroleum lamp bursting than of a common oil lamp.

THE TEMPERING OF STEEL.

Dr. L. Bradley said that at a late meeting Mr. Wiard said that the hardening of steel depended on the condition of the molecules, and in order that steel should be made perfectly hard and brittle, the molecules must be cooled one after another, and the piece be plunged into the water endwise. He, the doctor, had tried some experiments in this line. This piece of steel was hardened in the usual way, and it is very hard. The other specimen was cooled with two wet sponges, which is also very hard. Another piece of steel he heated to a cherry-red, and it is not quite as hard as the others, and can be bent.

PROPULSION OF VESSELS.

Mr. Thomas D. Stetson, in alluding to a late discussion, said devices for propelling vessels appeared thousands of years ago, and new plans are still appearing. The paddle-wheel system dates after the sucking pump. Of contrivances for propelling vessels there were patented in 1865, fifteen; in 1864, ten; in 1863, thirteen; in 1862, eight; in 1861, eight; in 1857, six; in 1855, sixteen; in 1854, ten. Thus 217 inventions have been patented in this country, and taking those that were not patented would make some 400. There is no subject that involves more profound mathematics than that of propulsion. By using a large paddle-wheel we get the

required dip, but no feathering; and hence it is claimed there is a loss from back-water. The number of inventions patented would show the vast amount of experiments tried; and still, withall, the paddle-wheel remains unchanged. We learn more from a failure than a success, and our failures have taught us that the original paddle-wheel is, so far, the best. What is wanted is a large area of paddle to avoid the slip, but with this plan there is a very large amount of friction, and it is not very practical to take hold of a large amount of water. In 1852 a steamer was made in New York with very expensive machinery, the plan of which was to take water in at the bow and let it out at the stern; and when the day of trial came it was found that the vessel would not tighten her hawser, though there was considerable commotion in the water, so of course it was not deemed proper to loosen the hawser to try it any further.

The Importance of the Erie Canal.

The Hon. William J. McAlpine, the distinguished engineer, next addressed the meeting; he said: There are few persons who appreciate the extent of the traffic on the Erie canal. If all the freight which is transported from the west and carried by all the trunk lines of railroad to tide water, were added together the traffic of the Erie canal would exceed them all during its season of navigation. We can hardly realize the immense business of the canals. The object of bringing this subject before the Polytechnic Association is to arouse such public attention to it as may lead to extending its facilities, and possibly to the adoption of steam on the canals. During the active season there are more than 150 canal boats going into Albany from the west every day. Most of these boats average from 160 to 170 tons, while some of the railroads do not average more than fifty tons. The canal brings eight to nine times as much freight as all the trunk lines together. Railroad trains make a great noise and bustle, like some people in the world, while the slow and silent canal boat excites scarcely any notice. No railroads, except coal roads, have been made with reference to economical transportation. Local interests have swerved them from their true direction. The grade out of Albany is 200 feet to the mile. There are no railroads located with reference to economy of transportation. And in reference to cheap transportation, it is a rule on railroads that every freight train, when within half an hour of a passenger train, shall switch off on a side track and there wait for it, hence the cost is twice as much as it ought to be, as

a train standing still costs the company as much as if it was running.

From a calculation he had made, he found that twice the time is lost on the New York Central, on the entire trip of a train than might be. Freight trains are run, in theory, twelve miles an hour, but in practice, from fifteen to sixteen miles; and as the cost of running a train is in proportion to its speed, so if we should run our freight trains at six miles an hour, we should certainly reduce the cost one-half. The wear upon the railway track is from one to two thousand dollars per mile per year; that is, the hammering of the car wheels on the track wears it out. Now this injury done to the track depends upon the speed; so if the rate of running is reduced one-half, the number of blows struck upon the track will be but one-half. Again, action and reaction are alike; blows are also struck back at the wheels, which are injurious; and knowing this, we build our cars very strong, and therefore carry three times as much weight as we should. These facts are becoming so evident there is no doubt but in a short time railroads will be constructed to carry our goods at a much less cost than now.

Improved Wheel for Railways.

Mr. John Raddin, of Lynn, Mass., exhibited models of his elastic and adjustable carriage and car wheel. He also exhibited a model of a locomotive wheel on this plan. The novelty consists in inserting hard rubber in portions of the wheel, between the journal and the rim, in such a manner that it will receive the concussions, yet will not be driven from its position.

The plan was subjected to considerable criticism. Several speakers thought a durable wheel could not be made in this manner. It was, however, deemed best to await the verdict of numerous engineers who, it was said, would subject the wheel to requisite tests.

Adjourned.

December 24th, 1868.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

New Ventilator.

Mr. N. Parrish, of Kalamazoo, Michigan, exhibited a model of his ventilator for heating and cooling buildings. It is called the Pendulum Fan Ventilator. The air is admitted at the bottom and passed

through valves into the fan, and through a box is carried to the furnace. Mr. Parrish said he was twenty-one years and two months in getting his patent! The ventilator was intended to be run with springs or weights, and one winding could easily be made to run thirty-six hours. The pendulum as its name indicates, vibrates, and the fan at the end of the rod causes the required commotion in the air. The width of the fan for ordinary use will be five feet long and three feet wide, which will heat a room at one-third less cost than any other plan.

Mr. C. E. Emery did not see why this apparatus should take less fuel to heat a room than any other contrivance. The fan being five feet long, from his calculation it would take ten strokes a minute to supply sufficient fresh air for fifty people.

Mr. John Johnson remarked that twenty-five cubic feet of air per individual per minute, and the lowest estimate is thirteen feet per minute. This is the amount supplied to the House of Representatives, in Washington. It is laid down as essentially necessary to have from fifteen to twenty feet per minute for all public buildings. The English Houses of Parliament and our Congressional Halls have appliances for doing this.

Electricity.

Dr. Vanderweyde performed some experiments with an electrical machine, and said: We have thus far considered air an isolating substance which prevents electricity from passing off from bodies. Electricity will not pass the distance of a quarter of an inch in a vacuum. This shows that there is no such thing as the electric fluid. A glass tube being exhausted of air by an air pump, and then filled with oxygen gas; the tube then being made red hot, shows that there is no such thing as caloric fluid, as the old books state; and is only a mode of atomic motion, as motion can be transferred into heat. Electricity is now known to be a state of matter. (Dr. V. exhibited a frictional electrical machine, the frictional plate being made of vulcanized India rubber.) The metal, he said, does not contain the charge, but it is on the surface of the glass, and not on the metal. The air touching the glass is also charged, more in summer than in winter. It has been proved that the air contains ten times more electricity in winter than in summer; and where there is no air there is no electricity. To prove that electricity does not pass through a vacuum, he connected with the electrical machine a glass tube filled with air, the points of the platinum wires being about three-fourths of an inch apart, and brilliant flashes of electric light

were seen. He next used a glass tube of the same size, but exhausted of air, when no electric light could be observed. The doctor, however, remarked that he could see a faint spark passing from the points, which he attributed to the glass tube not being thoroughly exhausted of air. In 1863, a dark spot was observed on the sun; this large dark mass must have moved over a space of some twenty thousand miles. At the instant when the darkness reached the earth, the magnetic needle in the observatories were disturbed, showing that when the shadow reached our planet, there was a "sunquake" which affected the needle. In making some experiments with the barometer he observed that by tilting it to one side so as to cause the mercury to run up and down the tube, flashes of light could be seen in the dark, caused by the friction of the mercury on the glass. There is also a vapor of mercury coming from the mercury, even in the open air.

The latest theory in regard to the magnetic needle is, that the currents from east to west are caused by the alternate heating of the earth by the sun during the day, and cooling again at night, and in that way influences the currents.

Dr. D. D. Parmelee said that, in order to get the electric light, it is necessary that a break in the current be made. He could not conceive how this could be made in the barometer. Is not the light seen in the tube the result of phosphorescence? A Leyden jar in contact with a receiver will not give off sparks, if they are not some distance apart from each other. He could not understand how Dr. V. inferred this to be electricity.

Dr. Vanderweyde replied that, when the mercury leaves the glass at the top of the barometer tube, it generates electricity, and the luminosity is due to the spark passing through the mercurial vapor. Phosphorescence and electricity are the same. The animals of the ocean that produce phosphorescence have some electrical apparatus that enables them to produce sparks. Many cases of phosphorescence are entirely due to electricity. Some twenty years ago he made experiments on the phosphorescence of sea water in Holland. The sea water runs in the canals of the city. He found that the water, when placed in a glass vessel, after resting a while, collected something on the top about half an inch thick, which he found to be monads, that gave a light when suddenly disturbed. There was no doubt but that the animalcules were the cause of the disturbance. He placed some slimy matter under the microscope, and found it filled with animalcules. Phosphorescence is of electric origin.

Dr. Feuchtwanger remarked that there was no difference between two pieces of sugar producing phosphorescence and two oyster shells after exposure to a beam of the sunlight.

Dr. L. Bradley said that near his house was an old decayed tree, which he cut down and laid in the open air; the weather was cloudy for four days after, when a fine sunny afternoon followed, and after dark that day all the wood seemed to be on fire. So, it seems, it requires the sun's rays to produce this effect, as the phosphorescence was not seen until the sun shone. The glow-worms will not shine unless they have been exposed to the sun's beams for some time.

Dr. Adolph Ott read the following paper:

On the Inflammability of Petroleum and Schist Oils.

By Dr. Robert Peltzer.

(Translated from Dingler's Polytechnic Journal, Vol. 189, page 61, by Dr. Adolph Ott.)

I have lately made experiments on the inflammability of different products of distillation which were derived from Pennsylvania petroleum and bituminous schists from Autun, Dept. Saône and Loire in France. The same were conducted in the refinery of Messrs. Cogniet, Maréchal & Co., and made by the special request of M. Cogniet. The following are the results of these experiments:

Petroleum.		Schist Oil.	
Density.	Inflammability. Takes fire at—	Density.	Inflammability. Takes fire at—
0.643	— 5.8° F.	0.769	+ 10.4° F.
0.686	— 5.8	0.791	66.2
0.700	— 2.2	0.805	95.
0.740	+59.0	0.814	118.4
0.748	+60.8	0.823	140.
0.750	+62.6	0.841	176.
0.760	95.	0.851	186.8
0.775	113.	0.880	208 4
0.783	122.	Portion solidifying at 59° F.	206.6
0.792	167.	Crude Schist Oil of 8.882	82.4
0.805	194.		
0.822	230.		
0.831	203.		
0.848	158.		
0.850	136.		
Crude petroleum of 0.802	59.		
Heavy oils from the distillation of kerosene.	343.4		
Paraffine of melting point 129.2° F.	429.8		

The oils were heated in a small capsule over a water or paraffine bath, a thermometer being inserted in the oil, and a thin burning wick being held over the same.

The petroleum oils which were experimented upon, were very differently obtained, a part of them were gathered directly from the cooling worms in refineries, others were obtained by fractional distillation in small retorts, and still others by evaporatio n of specifically light mixtures.

The two first samples of the density of 0.643 and 0.686 already took fire at 5.8 degrees Fahrenheit, henceforth the inflammability diminishes till the density of 0.822 is reached. From this point we again see it increase. This remarkable fact is easily explained, when we consider that the high temperature which is necessary to distil the oils of 0.822, is sufficient to produce a partial decomposition of the higher boiling oils in the retort.

This admission is sufficiently confirmed by the experiment. When the distilled oils had reached the density of 0.822, the fan under the retort was drawn out. In producing a light oil of 0.800, distillers generally gather only the portions which come up to this point; the first fractions which are used with the illuminating oil possess a specific weight of 0.750; the mixture does not then take fire below 96.7 degrees Fahrenheit. The remainder in the retort may be heated to 343.4 degrees Fahrenheit before it is inflamed by a burning wick. When, however, after the distillate had reached the specific gravity of 0.822, the heat was increased, as it is done for the production of lubricating oils; the inflammability was also increased, as is seen from the foregoing table.

Refined paraffine of a melting point of 129.2 degrees Fahrenheit could be heated to 429.8 degrees Fahrenheit; it then took fire, but without a prior decomposition being noticed, which obviously had taken place in the distillation of the heavy oils and crude oil containing paraffine masses.

The schist oil samples were obtained from a distillation on a small scale. The same was carried out in a cast-iron retort of two and one-half gallons capacity on naked fire. The oils were purified and from Autun. It is striking that the latter are a great deal more inflammable than the petroleum oils of the same density. Prof. Maroc, of Stuttgardt, also indicates the inflammability of a schist oil, which he does not designate further than as being at 63.5 degrees Fahrenheit.

It is highly probable that a similar decomposition goes on in the

distillation of schist oils at an elevated temperature, only in a less striking manner than is the case with petroleum. Unhappily, my choice was very limited, and I was specially in want of the distillates from the crude heavy oils for the production of lubricators, otherwise the decomposition of the schist oils could have been more precisely determined.

*Upon this decomposition a process could be founded for changing the heavy petroleum oils by a high heat (at least partially) into illuminating oils, as Mr. Breitenlohner, of Chlumetz, Bohemia, has already done with heavy peat oils.**

This principle has already found application in the refinery of Messrs. Cogniet, Marechal & Co., as yet, however, on a very limited scale.

From the foregoing table we notice a diminution of the inflammability with the increase of density, in case no decomposition has yet taken place by too elevated a temperature; but even an approximate relation between these two points is, however, not perceivable. If the greater or less inclination of the oils to inflame was simply dependent upon the boiling points of the single fractions, which would represent more or less constant mixtures of hydro-carbons of the series $C^{2n} H^{2n} \times 2$, as isolated by Cahours, Pelouse † and Schorlemmer ‡ then a fixed relation between the inflammability and density would be the necessary consequence; this relation is, however, very probably concealed by a different degree of absorption by the various "fractions" of the highly inflammable gases, which are met with in the oils.

A fraction which holds a certain quantity of gas, possesses also a corresponding inclination to inflame.

For making the crude petroleum applicable and perfectly safe for the heating of steam-boilers, it would be necessary to separate all the oils until the density of 0.783 is reached, and then to free it from the absorbed gases. Though oils may yet be present, which are inflammable from 1.22 to 1.67 degrees F., their percentage is so small that the fluid will bear a heat of 176 to 212 degrees F., without there being any danger of explosion. The oil below the density of 0.783 could be sold partly as kerosene, partly as essence for the so-called magic lamp.

After some discussion on the paper of Dr. Ott, the association adjourned.

* Polytechnic Journal of Dingler, CLXVII, page 378.

† Pelouse, Comptes Rendes, Vol. LVI., page 505; Vol. LVII., page 62.

‡ Schorlemmer, *Chemical News*, 1863, page 157.

December 31st, 1868.

Professor S. D. TILLMAN in the chair. Mr. C. E. EMERY, Secretary.

ISOMETRICAL DRAWING.

Mr. John Johnson spoke of the utility of isometrical drawing. There is no part of machinery, he said, but can be represented by it. All that is required is a T square and an equilateral triangle. Parallel lines are drawn, and the T square, held in different positions, forms the required angles. The whole system of isometrical drawing requires but the two instruments mentioned.

Mr. Dudley Blanchard remarked that the only difference between isometrical and the perspective drawing is that, in the former, everything is supposed to be opposite the eye, each portion of the drawing, while, in the latter, distant objects are of diminished size, which is accomplished by means of lines converging to one point.

ELECTRIC INDUCTION.

Prof. Vanderweyde delivered a very interesting address on electric induction. Induction means that a body is induced to become magnetic or electric from its own nature, without any magnetism or electricity being communicated to it. In speaking of the induction of galvanic currents, the lecturer said the induction only takes place at the moment that the current commences. It then develops another instantaneous in an opposite direction. When the current stops, another instantaneous current is induced in the same direction. On this principle coils have been constructed, consisting of an inside wire, which makes the current of the battery, and an outside wire, having no connection with the battery, but in which the instantaneous currents are induced. These instantaneous currents may be, in large machines, so strong that the spark of the charge has a length of ten to sixty inches. The professor here exhibited several small machines of this kind, and next explained the action of the condenser connected with those machines. They have a so-called contact-breaker, in order to interrupt the current of the battery many times in a single second, inducing as many secondary currents as this contact-breaker makes. This contact-breaker will soon become destroyed by the electric spark, therefore an arrangement has been invented to prevent this to a great extent, which consists of an imitation of the Leyden jar on a very extensive scale, however, condensed, in the space it occupies. This

arrangement is called a condenser. It consists of a great number of sheets of tinfoil, separated by oiled silk. Alternated layers of tinfoil are connected with the opposite and negative poles, so that the moment the current is interrupted the electric charge of the battery will flow on this condenser. This gives the additional advantage of uniting this charge with the original current, as the contact is re-established. The shortening of the spark causes the vibration to be more certain, by which the induced secondary current becomes much stronger. This condenser secures a trifling advantage. Its construction was here practically illustrated by taking a condenser of a Ruhmkorf coil-bar.

Dr. J. F. Boynton, at this point, asked permission to exhibit an apparatus which illustrated the subject treated by Prof. Vanderweyde. It consisted of a Geissler tube and a bar of vulcanized rubber rotating over it. The bar was made electric by friction, and its simply passing over the tube caused it to become luminous by temporary induction.

Elevated Railway and Pneumatic Dispatch Combined.

The remarks made at a previous meeting are here reported. Gen. E. M. Barnum explained in full by diagrams on the black board his plan for conveying passengers and packages and spoke substantially as follows:

In this age of inventive genius and progressive civilization, we cannot long abide by old and slow systems. As the stage coach has given place to the locomotive and the post boy has fled upon the advent of the electric telegraph, so a conviction of the impossibility of our city travel being much longer accommodated upon surface roads is gradually forcing itself upon the minds of the public.

Various plans for the relief of Broadway by subterranean roads have been submitted, chief among which are the "Central Underground Railway," chartered at the last session of the State Legislature, and the "Arcade Railway," which, though defeated at that time, will be again brought forward at the present session. Pending the practical realization of the underground ideas, let us see what plans are maturing for other modes of transit, and to what extent we can avail ourselves of other sources and conditions of motion.

A ready and sure way of relieving Broadway, and accommodating the far up town and Westchester county residents, would be to make some other avenues of travel and traffic capable of drawing off a large share of through transit from that great thoroughfare. The form of

Manhattan island, with Central Park occupying a large space midway of the North and East rivers, renders it practicable that most of the up and down town travel could conveniently be made along the margin of the city. The first obvious suggestion presenting itself in reference to any new plan, is that the details shall be such as to appear practical in operation, not too expensive in construction, and offering a sure inducement for the investment of capital. The difficulty is acknowledged, the public seek a remedy.

The accompanying illustrations present several views of a system for constructing an elevated railway and pneumatic despatch combined, as proposed by me, for operation along the margin of the city, in a continuous circuit from Harlem to the Battery, and thence to Manhattanville, with one or more crosstown lines, passing near all the railway depots, steamer landings, markets and ferries along the route. I have here shown an elevation of the road in front of warehouses or stores and over a cross-street, a car upon the track, and an entrance to one of the stations, which are provided in the second story of adjacent buildings, at convenient and frequent intervals along the line. I have also drawn the plan of bracing and strengthening the superstructure, the roof of a car, and the balcony floor in front of the station; the introduction of the pneumatic tube, made of light wrought-iron about twenty inches in diameter, and placed within the rails, girt, at every six or eight feet with an iron rib or saddle, having strong arms connecting to and supporting the rails at the same intervals, renders their alignment almost perfect. This tube is made with flanges at the top and bottom, and further provided with light longitudinal ribs of T or L iron, giving great supporting strength, and with diagonal bracing, rendering the whole structure a stiff net-work, from which it will be impossible for cars to be thrown by accident.

In another figure is shown a cross section of the road and car at a station, and a temporary frame for supporting telegraph wires, if any are encountered on the route.

ADVANTAGES OF THE PLAN.

The following advantages are claimed for the plan:

1. The corrugated wrought-iron columns combine great strength with simplicity and symmetry in construction, and will occupy no more space than is now taken by awning-posts, lamp-posts and telegraph poles. And with the elevated railway built, all those encum-

brances may be removed from the sidewalk and a better support for each attachment supplied.

2. These columns are so planted in iron bed-plates, or sills, that, by means of keys at the base of each, they can at any time be adjusted to a true perpendicular, rendering alignment and steadiness of the road perfectly practicable. Each sill is about two by ten feet on its base, and placed transversely to the line of the road upon compact earth, concrete, or rubble work. Foundations thus constructed will enable the sills to be laid without encroaching upon vaults or sewers, and leave the gas and water pipes each in the undisturbed possession of its own locality.

3. Upon each iron cross-head fitted to the top of column, and held securely in its place by substantial yet ornamental brackets, is placed a cross-tie of wood with intervening pads of India rubber, which will serve both to deaden the noise and to prevent crystallization and wear of iron from constant vibrations that would be communicated from the rapid movement of cars. By a simple form of rail-chair, combined with straps, bolts and nuts, the entire cross-head and the rails at each column are firmly clamped with the use of only four bolts and nuts, thus rendering the insertion of new ties, new pads, or new cross-heads an easy work.

4. The rails used on the road will have a depth of twelve or fourteen inches, admitting the use of car wheels with a flange of several inches in width, and will be distinguished for extreme lightness, with ample strength to effectually sustain the weight of loaded cars, the net-work of lateral and diagonal bracing between the rails and tube obviating, in a great measure, all vibrations which otherwise would occur.

5. The construction of this railway will admit of the introduction of lighter cars than on any other roads; they will be without platforms, with entrance at the side, and of sufficient length to seat thirty-five or forty passengers; there being no possibility of a collision with vehicles in the street, their bodies may be made more elegant than the present style of street cars, and, as neither mud nor bruising will reach them, they may be preserved externally as well as a private carriage. Ventilation can be provided at bottom and top, through the ends and underneath the seats; and the windows so arranged that no careless passenger can spit or drop aught on persons below.

6. Access to these cars being obtained only by stairs leading to station rooms in the second story of buildings along the line, the col-

lection of all fares will be performed at the entrance of stations. As no person can, therefore, ride without prepayment, so facilities are also given for excluding all drunken or lewd fellows and preventing the introduction of objectionable baskets and baggage. Car thieves and pickpockets will rarely operate here, but through the stations, and under the surveillance of a station keeper or a policeman. These stairways will always be within a building, not exposed to rain or snow, direct from the sidewalk, and easy of access to all. Ladies, children, and aged people will have equal facilities for getting into cars, as there can be no jumping on or off from the street, or while in motion.

7. A great desideratum for city passenger travel is uniform as well as higher rate of speed. On the elevated railway, by reason of regular stoppages at stations and the impossibility of collisions, cars may be run at a much higher average and more uniform rate than upon any surface road. Up town and down town cars being on independent tracks, at opposite sides of the same or in different streets, no delay on one can arise from temporary stoppage on the other. Neither public processions nor military parades, blockaded streets nor steam fire engines, will hinder a free transit for one moment. A fall of three feet of snow in a single night, or an accumulation of mud a foot deep, will make no interruption to the frequency or regularity of the cars.

It is not so much my purpose to investigate the details of this plan as to direct public attention to it as one of the proposed systems for city travel and parcel dispatch which is feasible and practicable, requiring a minimum amount of outlay, and entailing little preliminary expense in encroaching on private property or interfering with vested rights. The heavy expenses attending acquirement of property and rights of way in the underground plans are here greatly reduced, if not entirely avoided. The construction will not involve the demolition of a single building, the blockade of a single street crossing, nor an excavation larger than for the laying of a section of gas pipe. It must be borne in mind that however bad and faulty a line of surface railway might be an elevated way over the same route could be made with the smoothest possible running surface, and with easier gradients. Both the dangers and the delays attending the system of surface roads are lessened in a large degree. The encumbrances of mud or snow upon the track, the presence of a crowd of citizens or swarm of children, long lines of civic or funeral processions, excava-

tions for sewers and gas pipes, and the frequent repairing of streets are entirely absent. Signals and signal men at any angle of the road will be obsolete; street corners or ferry landings may be chocked with a hundred carriages, pedestrians may be endangered by the rush of a score of fire engines, the elevated cars with all their passengers will still pursue the even tenor of their way.

The Pneumatic Tube.

It is claimed that the combination of the pneumatic tube with the elevated railway renders this structure, both for city travel and for mail and parcel dispatch, a most compact, complete and admirable system. On whatever route the establishment of a line of cars for transportation of persons is required, there exists an equal demand for a rapid and regular traffic in mails, express, market, package, parcel and other light matter. The pneumatic way has not yet been introduced in America, either for the transmission of express or mail matter. But a power so simple and practicable, and which has been reduced to a perfect success in Europe, cannot much longer remain untried in our own country. By this application of an invention of Mr. E. P. Needham, of the firm of Carhart & Needham, of this city, I have taken another step in the development and introduction of atmospheric pressure as a motor.

How the Tube is Operated.

With the railway the tube serves a double office, viz.: That of constituting a foundation for the truss-work in supporting and bracing the rails, and that of operating an endless current of air. The *modus operandi* of dispatch business is by sending through the tube series of piston carriages or boxes, laden at each station with packages assorted and destined for other stations. The diameter of the piston carriages being less than that of the tube, and their support being upon two wheels, one at either end, they are driven through the tube at the same rate of speed (less slight friction and leakage) as is imparted by stationary engines to the current of air. This pneumatic dispatch is thus adapted for the rapid transmission of mail bags, merchants' parcels, city papers, loaded market basket, books, bundles, boxes, crates and all packages which can be placed within a carriage eighteen or twenty inches in diameter, and four to six feet in length. All carpet-bags, valises, and bundles which may be daily brought to the stations by thousands of passengers, will be dispatched through

the tubes. Even a puppy or a poodle may be ticketed unharmed, and as speedily as a satchel. The object attained, it is claimed, is very high velocity with perfect safety.

ITS PRACTICABILITY.

The great practicability of the pneumatic dispatch arises from that remarkable property of the atmosphere named *elasticity*, and from which it derives the power of exerting pressure in every direction and in all variations of temperature, altitude, or volume. The weight of a column of air upon each square inch of surface, at the level of the sea, is nearly fifteen pounds. Air compressed will, by virtue of its elastic property, exert a force as many times its own weight as the power employed to compress it, and will always expand to its original volume. This property in air, as well as in all aeriform bodies, is essentially different from liquids and solids, the latter losing by long compression a portion or all of their elasticity. It has been found, by careful experiment, that air will rush into a vacant space at a velocity of about 1,400 feet per second. If air is compressed into half its volume the pressure in the vessel or tube is equal to double the pressure of the external atmosphere, and, if permitted to rush out, it will do so with a velocity equal to that at which, under ordinary pressure, it would rush into a vacuum, viz.: 1,400 feet per second, diminished, of course, by the amount of friction among the particles of commingling air. There is nothing new in the principle of obtaining motion by means of a partial vacuum, nor is there anything incredible in the assertion that letters and small parcels can be transmitted from one place to another by a current of air in a shorter time than by any other means.

THE OPERATIONS OF THE TUBE IN LONDON.

The pneumatic tube, as a means of intercommunication, was first put into practical operation in London upon a small scale by the Electric and International Telegraph Company in 1860. To avoid inconvenience of repeating long messages, written papers, received at Cornhill, in the stock exchange, and other subsidiary stations, were blown through tubes to the central station in Lothbury. The company was so highly satisfied with the working of the tubes, and found so much convenience from their use, that they shortly put down others to more distant stations. The apparatus was of the simplest kind, consisting of an exhausting engine, the dispatch tubes,

less than nine inches in diameter, small cylinder carriages, and a few mechanical contrivances for opening and closing the necessary valves. A lad received all the dispatches with perfect ease, and the time occupied in transmission was but a few seconds, five to fifteen, according to distance. The letters and parcels were placed in the small cylinder carriages, which were roughly surrounded by felt, requiring no nice fitting or adjustment. All this, like Columbus' egg, appears extremely simple, now that it is effected, and the wonder is that the idea never occurred to those whose brains and pockets have been alike ransacked to provide a perfect system of express locomotion.

EXTENSION OF THE LINES.

The practical results of the working of these lines induced the formation of a "Pneumatic Dispatch Company," with a royal charter, possessing power to lay down tubes at any point within the jurisdiction of the Metropolitan Board of Works in the city of London. They are now rapidly constructing lines to connect the ten district post-offices with the general post-office; and they propose, also, to extend lines between the different railway termini, the goods depots, the principal London markets, and other important points. The first line of this company was laid from Euston square, near the Northwestern railway station, to the post-office in Eversholt street, about a half mile. These tubes are two feet nine inches, by two feet six inches wide, a section being similar to a railway tunnel in miniature. A speed of thirty-five miles an hour, practical working, was immediately obtained, with an atmospheric pressure of only four to six ounces to the square inch. This line is circuitous, and with gradients of one in sixty, one in forty-five, and one in thirty-five.

OPINION OF AN EXPERIENCED ENGINEER.

An experienced engineer writes thus of this line:

Next to the electric telegraph, this is the most beautiful invention of the age, and we doubt not it will prove one of the most useful. We say this with the most perfect confidence, after seeing its practical operation at the Electric and International Company's office. The Pneumatic Dispatch Company propose to enlarge operations without delay, and their plans will be upon a scale which will enable them not only to transmit papers and packets, but to deal as well with packets of considerable bulk.

1. The transmission of all mail bags between the post-office and the railway stations, and the several district stations.

2. The conveyance and delivery of all the small parcels of the railway and express companies.

3. The conveyance and delivery of all ordinary packages from the newspaper offices, stores and markets.

Nor is the principle of pneumatic transmission applicable to public undertakings alone; it is equally useful for private purposes, as by a separate system of branch tubes all great commercial houses on or near the lines can instantaneously transmit their dispatches or parcels in separate carriages to all parts of the city.

DESCRIPTION OF THE NEW TUBES.

Yet greater practical results have been manifested by the opening of the Pneumatic Dispatch Company's tube on a larger scale, from the company's office in Holborn street, thence southward under Seven Dials, thence in a curve northwesterly under Tottenham Court road, crossing over the Metropolitan railway at Euston road, thence northeasterly to Euston station, a distance of nearly two miles. This line is formed of a continuous cast-iron tube of the horse shoe section, in nine feet lengths, the internal dimensions being five feet six inches horizontally, by five feet vertically. Those portions of the tube on short curves are constructed of brick work. The carriages, or trucks, are about ten feet in length, resemble in form an ordinary open goods wagon, the ends being raised above the sides, and presenting an outline conforming to that of the interior of the tube. The edges of these trucks are bound with an elastic medium, although a space is left between the truck and the inner face of the tube; a perfect fit not being required for working the dispatch. It is found that no inconvenience arises from leakage, while in the case of a close fit the results of friction would prove prejudicial. Each truck will carry about one and a half tons of mail matter. Trains of four trucks are run, making a gross load of nearly ten tons, at a rate of thirty-five to forty miles an hour, with a blowing pressure of only six ounces per square inch. In ordinary steady working, twenty-four trains of about ten tons each are carried through each four hours. The machinery by which the transit of this weight of trucks is effected consists of two engines of twenty-four inch cylinders, twenty inch stroke, operating a fan twenty-two feet in diameter. Ordinarily this fan works at one hundred and sixty revolutions, giving a pressure equal to six

ounces per square inch, but pressures of three quarters of a pound are within reach. The cost of working, including engine, fuel, attendance, and all establishment charges, is found to be less than one penny per ton per mile. Many persons have availed themselves of the novelty of a ride through these tubes in total darkness, from Euston to Holborn and return. The time usually occupied is five minutes. A traveller says:

The only inconvenience experienced was at the commencement and termination of the journey, where a sensation was felt in the ears very similar to that which occurs on descending in a diving bell.

What is Proposed to be Done.

Many of our readers will remember the working section of a pneumatic railway for passengers at the American Institute fair, in October, 1867, which fully demonstrated the simplicity and the applicability of this power. In the elevated railway and pneumatic dispatch combined, Mr. Barnum only proposes at first to apply this principle to mail and parcel transit through the tubes, operating the passenger cars by light dummy engines, placed in the rear of each, so constructed that the machinery is out of view, there being neither toothed gears, bell, or whistle, and no puffing noise or visible escape of the exhaust-steam; the fuel used being selected with a view of making little or no smoke. These cars can run easily around a curve of thirty feet radius, so the road may be adapted to the streets on the margin of our city. It is claimed that this route proposed will largely accommodate passenger transit between the extreme upper and lower ends of Manhattan island; that it will add twofold to the amount of parcel express matter, and double or quadruple travel in a short period of time. The surface rails can be left for heavy goods traffic, which must always be increasing about the shipping, the markets, and the ferries. No man, however sanguine, believes that an underground or tunnel will be constructed from City Hall to Central Park in less than five, nor from the battery to Harlem in less than ten years. An elevated railway could be built on both sides of the city in less than two years.

The Cost.

The London tunnels, including right of way, stations, and equipments cost over $5,000,000 per mile. The nature of the dirt and the difficulties there encountered are altogether different from those

in New York. When we reflect to what extent our streets are obstructed by the laying of a gas pipe, the repairing of a sewer, or the excavation of a large cellar, what blockades may not be expected during the time of opening a great cut of dimensions wide and deep enough to admit laying a double track and bed, and covering it with solid masonry laid in water-proof cement. That an elevated road can be built airy, light, and yet substantial, would seem practicable. And when the economical features, both in construction and operation, are compared with an underground road, they will doubtless be considerations that will commend it to public favor on the borders of the city, for realizing greater safety, economy, and expedition, than can be obtained by any other locomotion. By the introduction of vulcanized rubber or elastic tire upon the car wheels, the working of the system will be comparatively noiseless, and better adhesion and traction attained.

The Objections Answered.

It will be urged by some that cars moving rapidly on the elevated ways will frighten horses. When railroads first began to invade the rural districts, they were opposed by the same objection. Farmers everywhere met the surveyors and engineers, exploring for locations, with the prohibitory injunction, "thus far and no farther shall you come." It was declared that it would be impossible to drive a horse upon a public highway within sight of a screeching locomotive and its train. A horse, like some men, will scare at anything new, but both easily become use to it. Midst the din and smoke of battle cavalry horses become unterrified as readily as their riders. Who has seen the noble steeds attached to city fire-engines dashing along the streets, and not had a greater admiration for good horse sense? Who has observed spirited spans at railway depots, as trains came thundering in, and not had the thought confirmed, that next to a good woman a fine horse is the most admirable gift vouchsafed by God to man?

Conclusion.

In this plan for an elevated railway and pneumatic dispatch, special attention has been given also to minor details. As along each thoroughfare lines of telegraph poles are established, a neat frame-work is provided at intervals over the cars, to which all wires may be transferred, without changing their tension or interrupting their use, whenever it becomes necessary to remove one or more of the poles.

Adjustable brackets clamped to the columns, for the support of all awning frames, will permit each store occupant on the route to attach his awning high or low, inside or outside of the columns, at pleasure. The street-lamps can be attached to the columns, affording a surer protection to the gas-pipes and lamps, and enabling a removal of the present posts. And whenever the city or individuals may choose to increase the number of lamps the supporting columns are all provided. Station lamps placed over the balconies will amply light the ingress and egress of each car, and being accompanied by a movable colored disc, with wires leading to the master's place within, will enable him at all times to signal each car-driver on his approach, so that no delay shall occur in stopping at a station in which there are no persons waiting. Uniformity of velocity, a point most to be sought for in these ways, is thus greatly enhanced. The minor details of the pneumatic dispatch, viz.: Stopping, starting, working automatic signals, operating side branches, employing auxiliary stationary engines on long reaches, &c., will be determined by the special circumstances of each case. In starting, the power of the rotary pump or fan is communicated so gently through the elastic medium (the air in the tube) that, though motion is produced almost instantaneously in all parts of the circuit, there is no jar or violence calculated to injure anything. In stopping, the discs of the piston carriages infringe upon a cushion of air at the station with such perfect elasticity that the carriage is brought to rest without the least jar. No collision can possibly occur, as all parts of the air column within the tube moves in the same direction at the same time. There is no possibility of running off the track, and, as in the case of the modern velocipede, the more rapid the motion the more direct and easily will the piston carriage, running on a single track at the bottom of the tube, hold its upright position, without bearing laterally against the inner surface.

Upon the score of both capital and time, required to complete an underground or elevated railway, unquestionably the comparison is largely in favor of the latter plan. And the question after all is, will it pay?

If, as is claimed, a double track elevated way with pneumatic dispatch can be built for less than five per cent of the money, and in less than ten per cent of the time, required for an underground road, certainly it is worthy the careful consideration of capitalists and citizens.

The elevated way can be completed from Harlem along the east side of the city to the battery, and thence upon the west side and along Tenth avenue to Manhattanville, within two years. Laborers can work at many parts of the road without obstructing each other, and a large portion can be finished in one season after contracts for the iron work are concluded. It may be utilized from point to point as rapidly as completed.

A net-work of these roads could be built up and down each avenue along the whole extent of Manhattan Island for a less sum than will be required for a single tunnel.

On this plan there will arise no blockading of streets, no change of grade, no displacement of sewers, no interference with gas or Croton pipes, no removal of foundations, no encroachment upon vaults, no blasting of rocks, no undermining or demolishing of buildings, and but little removal of pavements and excavation of earth.

The excavations made for the London tunnels were ninety-four feet in width by twenty-two feet in depth. Whole blocks of buildings were undermined, and, in many cases, the Metropolitan Railway Company were compelled to purchase the property or pay heavy damages.

For such a roadway in New York, let any person undertake to picture in imagination the work of cutting this great chasm, of laying the walls and arches of solid masonry, of replacing all the sewers, gas and water pipes, and the repaving of the surface streetways, and he will scarcely approach the reality.

Travel by street cars in this city has quadrupled in ten years. The total number of fares collected in the year 1867 was over 93,000,000. In 1868 it will exceed 100,000,000. With adequate facilities, by the year 1876, the centennial anniversary of our national independence, the number will reach 200,000,000.

And how are all these to be accommodated? Something must be done now. How many men believe that an underground road will be built in ten years? Or who believes it can be done in five years? Meanwhile, elevated railways may have served the pressing demand for city travel, and have declared ten or twenty semi-annual dividends.

The surface roads fail to accommodate this vast increase of travel. Public convenience cannot permit many other tracks to be laid along the avenues.

Before resorting to more extreme and expensive measures, will it not be a wiser plan to make available the open and unobstructed ways above us?

Why go down into the mud and quicksands, amidst the rocks of a subterranean route; or why trespass upon the crowded ways and occupy private basements when there is ample room and verge enough in the free air above in which to construct a dozen elegant and substantial railways the entire length of the island?

Why expend a score of millions in work prolonged through many years, when a fraction of the money will afford ample and substantial relief in the same number of months?

Why undermine, tear out and blockade Broadway, or any other great public thoroughfare, for an indefinite period of time, or subsidize vast values in public rights and private interests, when the way is open for building city railways which offer a quicker and cheaper means of transportation?

Public opinion is disposed to condemn all new things. It is conservative on inventions, and prefers to travel in old ruts. The earliest propositions of all inventors, and great improvements in every age, have at first met with fierce opposition, ridicule and contempt.

The experimental railway in Greenwich street, and the delays in its construction, have served to prejudice the public mind against all elevated railways.

Its motive power will probably be a failure. It certainly is not the best. Endless wire ropes of half a mile in length, trundeling over scores of pulleys and sheaves, never can be depended upon for great speed and immunity from accidents.

A stoppage in one part of these ropes would blockade the whole road.

Its method of alignment appears very imperfect, and it does great injustice to that reputation which American constructions of iron have everywhere acquired, "as proverbial for lightness and symmetry, with sufficient strength for the uses required." But it is the first step toward the city elevated railway.

The first steamboat on the Hudson was not much like a St. John or a Dean Richmond, and the earliest locomotive did not much resemble those of the present day, but the idea in each instance was a correct one. Let capitalists and inventors unite, and we may have an elevated structure which will be the city railway of the future.

The following is from the *New York Times:*

Pneumatic Locomotion—Historical Sketch of the New Locomotive Power.

The exhibition of a section of pneumatic railway in perfect operation at the late American Institute fair, attracted numerous visitors to that exposition of the results of nature, talent, enterprise and industry, and did not fail to awaken public curiosity as to the history of this agent of locomotion. We have pleasure in giving our readers a brief sketch of the progress made since the earliest ventilation of the idea of this application of pneumatics, with such facts and figures as will illustrate its progress, show what is now being done, and the plans on foot which promise to enable us before many years to "raise the wind" at will and blow ourselves not only through our cities, but, if the principle holds out, and the enthusiasts' dreams are realized, from continent to continent with all but telegraphic speed.

Historical Sketch.

Until somebody digs a pneumatic railway from beneath the ashes of Herculaneum or Pompeii, or by such a discovery at some other source startles us again with the oft-repeated saw that "under the sun there is nothing new," we are content to take it for granted, as set down upon the records, that the first attempt to use atmospheric pressure as a power for locomotive purposes was that made in 1810 by a Danish engineer named Medhursz, who then, it is said, originated the idea of carrying mail matter in a pipe. Too little is said of his labors to lead us to any other conclusion than that, like many other men of genius, his labor ended when the seed was sown; the harvest was for those who followed after. Following him, we have an Englishman named Vallance who, in England, in 1824, not only exhibited plans for the pneumatic dispatch carrier, but also those for the conveyance of passengers by the same agent through London. It was not, however, until 1832 that plans were so matured that they obtained much favor with the public, always slow to move. From that time, however, until 1838, the question of pneumatic locomotion was well canvassed, resulting, in the latter year, in the patenting of plans by Clegg and Samuda, which capitalists considered practicable. These plans, nevertheless, were not put into operation for a considerable time. The atmospheric railroad from Dalkey to Kingston, near Dublin, Ireland, was the first constructed, in length about two miles. Soon after followed that in Croydon, England, over six miles long, and in 1845 that of St. Germain, near

Paris, to Nantienes, distant about two miles. These were conducted with varying success, and, of course, with varying popularity, the main difficulty in the way being the heavy expense of working, spite of all promises of economy.

The first successful apparatus is thus described: Unlike the late methods where the cars pass through a tube, the first pneumatic propulsion of vehicles was done by an apparatus which lay between the rails, upon which the cars ran. At the top of this tube or pipe of cast-iron, properly strengthened by circular flanges eccentric to the tube, was a longitudinal gearing, the sides of which were planed tapering upward; a band of iron of the thickness of the tube was made to fit the opening. Over this a band of leather was placed, extending some distance on each side of the iron band to which it was firmly fastened. The part extending to one side was used as a hinge for the valvé. This was firmly pressed, throughout the whole length of the line, against the tube, by means of a bar of iron. The part extending on the other side rested on the tube in the place where it had been planed smooth. Every time a train passed over the line, the leather was impregnated with tallow and wax, and was pressed by a roller against the tube, on which it adhered, closing the opening. The closing became more perfect when a vacuum was made inside the tube; one of the results of the atmospheric pressure being to force the leather against the opening. When the vacuum was formed within the tube, the cars attached to the piston therein were drawn with it toward the location of the power creating this vacuum. The tube was closed at each end, where the engines and air-pumps were situated, by valves of peculiar construction, which allowed the piston to go in and out freely and smoothly without letting in the air. Numerous other plans were conceived and experimented upon, all however, being but modifications in some way of those of Clegg and Samuda, the perfectors of the Medhurst invention. The atmospheric railroads upon this plan do not seem to have had, by any means, a healthy life of it; the longest lived, we believe, was that in Ireland, which died about five years ago, being succeeded by the better understood steam locomotion.

The Pneumatic Dispatch in England.

The comparative success attained upon the roads above named was sufficient, however, to create a lively public interest wherever an inventor claimed to have discovered the remedy for the difficulties

which impeded the healthy working of the project; but it was not until in 1861 a company was formed in London, entitled the Pneumatic Dispatch Company, and that they laid their plans before the public, that confidence in the ultimate realization of a successful atmospheric railroad was established. There was nothing new in principle claimed by the invention in the hands of the new company, but its application was materially different; and to this, and to modifications of this improvement, are due not only the success which has attended the labors of six years, but, beyond a doubt, the great revolution in locomotion which is still before us. The first experiment with the new apparatus was made in Battersea Fields, on the south side of the Thames, in the southwest suburbs. An iron tube over a quarter of a mile long was laid along the river's bank, and mail bags, parcels, and even several of the workmen, were carried through it at a rapid rate. As before stated, the principle by which this was effected was the same as that upon which the former roads were constructed; the great and important differences lay in the application. The car was no longer drawn over rails laid alongside a tube, but with its load passed through one of sufficient diameter to admit it as a piston. There was still the tube and the exhausting apparatus, but self-sealing valves were no longer necessary. The tube was not circular in form, but of a section resembling that of an ordinary railway tunnel, the internal height two feet nine inches, and the width at the spring of the arch two feet six, and at the springing of the invert two feet four inches. The material of the tube was of cast iron, in nine feet lengths, each weighing about a ton, and fitted into each other with an ordinary socket joint properly packed. Within the tube and at the lower angles on either side were cast raised ledges, two inches wide on the top and one inch high, answering the purpose of rails for the wheels of the dispatch truck to run upon. The trucks were made of a framing seven or eight feet long, inclosed in sheet iron, and having four flanged wheels, twenty inches in diameter each. The truck was so formed that its external form, in cross section, conformed to the inner surface of the tube, although not fitting closely, as this was found to be no necessity of successful operation, and freedom from friction, beyond that of the wheels, was thus obtained. The air was exhausted from near one end of the tube, by means of a great exhausting fan from which the air obtained by the suction was discharged by centrifugal force.

These first experiments, which were made in July of 1861, as

above stated, were most successful, and received, as they merited, a great deal of public attention and commendation. The Electric and International Telegraph Company, it is true, had for several years used tubes, through which, on the same principle, they had dispatched messages between their city stations; but the invention of the all but perfected apparatus above described is due to T. W. Rammell, a civil engineer, who became the secretary of the new company. The company was organized under the chairmanship of the marquis of Chandos, and from the outset obtained a most generous support. Charters were granted for the opening of streets to lay down tubes to establish a line between St. Martin's-le-Grand to one of the district post-offices, and subsequently to connect railway stations, public offices, &c. Early in 1863, the company had already made rapid forward strides, having established a most successfully working connection between Euston terminus of the London and Northwestern railway and the district post-office in Eversholt street. Through the pneumatic tube connecting these points, 1,800 feet long, all the mail matter brought into the city from the north and northwest by this great carrier was transported with great saving of time and labor, and assured safety to the mails. Fifteen great mails per day were thus transmitted.

In 1864 a tube, or rather tunnel, was constructed in the grounds of the Crystal Palace at Sydenham, 600 yards long, through which thousands of passengers were carried, propelled by a current of air generated by an immense fan, and again drawn back by a vacuum created by that instrument. The conveyance was a long, roomy, comfortable carriage, resembling an elongated stage, and capable of accommodating thirty passengers. Passengers entered this at either end, the entrances being closed with sliding glass doors. Fixed behind the carriage was a frame-work of the same form and nearly of the same dimensions as the sectional area of the tunnel or tube, and attached to the outer edge of this frame was a fringe of bristles forming a thick brush. As the carriages moved through the tunnel the brush came in close contact with the arch, thus to a sufficient extent preventing the escape of air. With this elastic collar around it, the carriage formed a close-fitting piston, against which the propulsive force was directed. Notwithstanding that there was a curve in the tunnel that was very sharp and the gradients as high as one in fifteen, the motion was easier and steadier than ordinary railroad traveling. The journey of 600 yards was performed either

way in fifty seconds, with an atmospheric pressure of but *two and a half ounces* to the square inch.

However successful all these experiments were, it was not until early last year, that operations upon a scale commensurate with the importance of the project were inaugurated by the opening of the extensive dispatch line from Euston square to Holborn, a distance of nearly two miles, whence it has since been extended to the general post-office, another mile eastward.

On the opening day the duke of Buckingham, then and now chairman of the Pneumatic Dispatch Company, had invited a number of scientific gentlemen to inspect the apparatus. It is narrated that after the train had made some successful passages, several of the gentlemen entered the dispatch trucks and passed through with but slight inconvenience for want of room, having to accommodate themselves to the narrow boundaries of the trucks. The sum of all these tests was that the public became satisfied, not only that the dispatch system was a success, but that an application of the principle to passenger traffic was demanded by the necessities of the time. The Pneumatic Dispatch Company have, however, confined themselves in the meantime to the work for which they organized, and during the past eighteen months have laid many miles of tubing, and by their success given the impetus to others who propose to carry out a scheme for passenger traffic on the most extensive scale. A company was formed last year who proposed to tnnnel the river Thames, and through that tunnel transport passengers on the pneumatic plan.

The Waterloo and Whitehall Pneumatic Railway.

This is the title of this great project, which aims at connecting the two great sections of the greatest city in the world; and through this tube it is proposed to pour from side to side, an endless living stream of human beings, at the rate of eighty-eight feet per second, making the distance in a fraction of a minute. The approach to the river's bank, from either terminal station, will be by an underground tunnel of brick-work, a large portion of which has already been constructed. The river will be crossed by four lengths, each two hundred and twenty-one feet, of wrought-iron tubing, thirteen feet in diameter, covered with brick-work. These tubes, which will soon be completed, are the work of Messrs. Samuda, of the Isle of Dogs, up the Thames a short distance, and are of three-quarter inch iron, with

three rings of enveloping brick-work bound by hoops of angle iron, and are to receive, after being laid, an internal lining of brick-work, bringing the diameter to twelve feet nine inches. The length of the tubes, including the shore ends, will be five-eighths of a mile. The first of these will soon be completed, when it will be floated down the river from the workshop to its destination.

This floating down immense masses of iron and masonry is not the least astonishing feature of the affair, and will be effected in this way; the ends of each section will be closed by bulkheads, thus rendering the air-inclosing tube lighter than its bulk of water. When it reaches Hungerford, its destination, it will be, by a moderate admission of water, lowered down into its final resting place on the foundations prepared for it, in like manner with the other sections. The ends will be brought together by means of guiding rods, and a close joint tube be effected by an ingenious method lately devised by Mr. Kammell.

This great enterprise may be said to be the first ripe fruit in half a century from the invention of Medhurst the Dane. This project once a success, it is scarcely too much to expect that the long dreamed of feat of subtubing the Straits of Dover may be in time accomplished.

The Pneumatic Railway at the American Institute Fair.

It would be, indeed, surprising if the inventive genius of this country had continued to sleep while the progressive labors above detailed were going on in England. The matter of underground railroads has been twice before the Legislature of this State; and last year two bills were presented, asking for the right to form a company and the necessary charter to enable it to run pneumatic tubes for mail dispatching purposes through this city. These bills, like many others, died a permature death in Albany, but with them did not die all hope in a successful future for the pneumatists, if we may coin a short name for them for convenience sake. Charters were obtained in Massachusetts, Connecticut, New Jersey and Pennsylvania, and it is understood that two bills for New York will be again presented with best guarantees of success at the next session of the Legislature. In the meantime our spirited neighbor, Mr. Alfred E. Beach, of the *Scientific American*, is the first in the field with his demonstration of the practicability of pneumatic passenger locomotion, made on an actual working scale. The splendid example of a pneumatic railroad erected at the last American Institute fair, and which was in successful operation, is the project of that gentleman; and it is not too

much to expect that this enterprise will be duly appreciated and in time rewarded.

In the construction of this great working model, there are some peculiar features which will call for explanation as we proceed in the description of the construction as a whole. Beside the great tube for experimental passenger conveyance, there is a full sized model of a pneumatic dispatch with noticeable improvements, which we shall also have to notice in this article.

The tube of the passenger railway at the fair was suspended along the eastern wall and from gallery to gallery, a distance of 107 feet. It is six feet in diameter and is constructed of wood. The shell is but one and a half inch thick, yet it is claimed to be capable of immense resistance. This peculiarity is obtained by a novel process patented some time since by J. K. Mayo. The inch and a half in thickness is made up of fifteen layers or lamina of veneer, laid upon each other transversely and spirally and joined together by cement. The grain of the woods thus crossed and recrossed, gives a structure of remarkable strength and power of resistance to either blow or pressure. The carriage for passenger conveyance is long enough to seat on either side, like the ordinary street car, ten persons. It is open at the top and sides, the latter rising sufficiently high only to protect the passengers' backs from friction against the sides of the tube. The door is placed in the center of the O shaped end which forms the valve or piston when the door is closed. The wheels of the car, four in number, rest on rails laid along the bottom of the tube and project through the bottom a few inches only, being all that is necessary. The wheel attachments and, with this exception, the wheels themselves are immediately beneath the seats. This permits full use of the space within the tube, so that the carriage is just as freed from touching the bottom as the sides. The motive power, placed at the northern end of the tube, consists of a great fan ten feet in diameter, inclosed in a wooden chamber which forms one end of the tube. This fan is unlike any yet used. It is in fact a screw propeller with eight blades, so constructed that the pitch of the blades is not more than twelve inches. This fan is driven by an engine placed near by, and will make, if necessary, two hundred revolutions per minute. Turning in one direction it produces a vacuum by exhausting the air from the tube and throwing it off through apertures in the chamber, thus drawing the car at the other end rapidly toward it. When its motion

is reversed, the opposite result is, of course, produced; the volume of air then taken from the surrounding atmosphere is poured in a resistless stream against the piston or flange of the car, which flies before it back to its starting place. This construction of wheel is the invention of Mr. Beach, and is now for the first time put to practical test on a large scale. We hope to be able to chronicle, in a few days, that the result has realized the best wishes of our fellow citizen. It would be most gratifying to learn that, so early in the race of pneumatic railroad construction, there was such promise of our taking the lead at a single bound. The construction of this apparatus, and that about to be described, was done by the Holske Machine Company, and was superintended by Mr. W. T. Holske and Mr. Beach personally.

The Pneumatic Postal Dispatch Tube at the Fair.

Mr. Alfred E. Beach also exhibited at the fair a section of a postal dispatch, through which a truck for the conveyance of mail matter is drawn or propelled in the same manner as above explained. A smaller fan is used for this tube. The tube itself is square, as are the trucks which pass through it. In connection with this apparatus is an ingenious automatic arrangement, showing how mail matters, received at different post-office depots along the route, may be kept separate and so delivered, and in like manner can a correct delivery at each station of outgoing mails be effected. This is possibly the most interesting feature of this most attractive exhibition. The lamp-post rising from the middle of the tube represents a street depository, having in its base a pair of rotary letter boxes. Every time the car passes the letter boxes one of these is turned, and its contents drop into the passing car. When the car returns, the other box is operated and its contents collected in like manner. Thus, the car, when passing up town, collects all letters destined in that direction, having been dropped into the receiver of the lamp-post; returning, the down town letters are collected from their particular box, into which they have been dropped advisedly from above.

Projects.

On the success of these practical tests under the auspices of the American Institute no doubt will depend in a measure whether we shall have any immediate realization of the several projects in view, including not only the establishment of passenger traffic and the

transportation of mail matter, but the scarcely less gigantic one of sub-tubing the North and East rivers and thus uniting Jersey city and Brooklyn with New York.

It is estimated that the actual expense of laying down pneumatic passenger tubes under the streets of the city in the best manner with iron tubing, including the running stock and engines, would not exceed $100 per running foot, or $500,000 per mile, being much below the estimated cost of an underground steam car railroad. The pneumatic plan would, doubtless, require a smaller tube than any other form, and, consequently, less excavation would be required, and since, by actual experience, it is shown that it can describe the sharpest curve, the route would not be difficult of selection. The suspension of the tube at the fair illustrates the practicability of an elevated road, and suggests that the tube might be readily placed on posts or on brackets projecting from the houses passing between the blocks, or even running over the house-tops.

The estimated cost of laying down the pneumatic passenger railroad tube under the East river is $200 per running foot. Estimating the distance at 3,000 feet, this would give an outlay of $600,000. Assuming this to be correct, the contrast between this sum and the $7,000,000 which the great suspension bridge is to cost, the difference is startling. For the larger sum it is claimed that a dozen or more pneumatic tubes could be laid down, affording ample trans-river accommodation at every important point on either river, connecting all the great leading thoroughfares of the sister cities.

It is further estimated that passengers by a through city tube could be carried from the City Hall to Madison square in five minutes, to Central Park in eight minutes, to Harlem and Manhattanville in fourteen minutes, to Washington Heights in twenty minutes, and by sub-river to Jersey city or Hoboken in five minutes and to the city hall, Brooklyn, in two minutes. And that this, if ever accomplished, which is by no means improbable, ought to be done at rates of conveyance far below those now charged for most uncomfortable transportation, it is only fair to conclude from the comparatively limited outlay of construction anticipated.

The projected pneumatic postal dispatch is of a very important and comprehensive character. It is proposed to carry a pneumatic tube of about two or three feet in diameter from the post-office up Broadway to Forty-second street, with branches at Twenty-seventh street to the Harlem and New Haven railroads, and a branch at

Thirteenth street to the Hudson river railroad. A tube is also to girdle the city, passing through South and Washington streets so as to touch all the ferries and landings where mails arrive and depart, bringing these points into immediate communication with the general post-office. Tubes are also to extend through Chatham street, Bowery and Third avenue, also along Broad, Pearl, Canal, Grand, Bleecker and Fourteenth streets, and wherever the public requirements may need them; all the sub-post-offices are of course being connected with the general post-office. Further, it is proposed to extend the postal tube under the East river, or over the suspension bridge, if constructed, to Brooklyn, and through the principal streets of that city, also under the North river to Jersy city, where it will connect with the Pneumatic Dispatch Company of New Jersey, to whom, as before stated, a charter has already been granted. By this company it is proposed to extend their lines as soon as possible to the nearest important cities, probably Newark and Elizabeth. By means of such a net-work, no doubt the mails of the suburbs and suburban cities would be delivered at head-quarters with great rapidity. The postal cars, it is stated, could be run at the rate of thirty miles per hour, including all delays at intermediate stations. Thus, letters might be sent up town as high as Forty-second street, and replies received almost with the speed of telegraphic messages. The advantage to business men could not be over-estimated, assuming successful operation of such a project. At the present time we know that letters, in many cases, must be deposited ten or twelve hours up town prior to the mail-closing hour down town, so as to secure transmission by that mail. Letters for the early mails must be deposited on the night before, or they fail to go, and to send a letter up town and expect an answer on the same day would be to hope against hope. In this connection it is only necessary to say that in whatever respect a pneumatic dispatch would be of value as a mail bearer, it would also be valuable as a bearer of packages, and not by any means its least important business would be the delivery of newspapers at the various depots for the sale of that most valued necessity and luxury *juncto in uno.*

Leaving to the imaginations of our accomplished readers the pleasant labor of converting, with all the material here afforded them, our confused and crowded city, with its no less crowded water boundaries, into a terrestrial paradise, where easy locomotion on land, on water, beneath them both or in the air, can be enjoyed at will, we close this

article, hoping, with them, that out of this great field of promise we may some day soon pluck flowers of comfort.

A New Dynamic Indicator.

The following paper contributed by Mr. C. P. Leavitt, on the "Perpetual Dynamic Indicator," was then read by the secretary:

The object of the dynamic indicator is to register the average amount of power transmitted from a motor to a revolving shaft, and is intended to supersede the ordinary dynamometer where great accuracy is required. Unlike the ordinary form of dynamometer, in the use of which the force and velocities of the motor must remain nearly constant, in order to arrive at reliable results, this instrument is not affected by changes in the power which it is intended to register; but shows by the number of revolutions of a countershaft, the *average* power which it has transmitted in a given time; and by the speed of that countershaft, the power which it is transmitting at any particular moment of time. This result is accomplished in the following manner:

To a shaft which is to be driven, a pulley is fitted to revolve loosely between two collers. Firmly secured to the shaft is a pile spring, the extremities of which connect with the pulley by a proper articulation, so that such power as may be applied to the pulley must be transmitted through the spring. Any variation of the force applied to the pulley will thus cause it to slightly move upon the shaft. Outside of the hub of the pulley, a radial bar is firmly attached to the shaft, which extends nearly to the face of the pulley, where it forms a fulcrum for a swinging bar, also radial. The short arm of this swinging lever is made to press, by means of a light spring, against a piece of steel fitted to the edge of the pulley; which piece of steel is properly inclined to the plan of revolution, so that as the pulley turns upon the shaft, the swinging lever shall make a corresponding motion parallel to the shaft. The lower end of the swing lever connects with a sliding boss upon the shaft, which revolves with it. A circular disk of rubber is fitted to this sliding boss, and it is turned to a very fine edge where it presses against, and rotates a small light cone, which is adjusted with one of its sides, parallel to the shaft, in such a manner that as the boss is moved by the variation of power to different positions upon the shaft, the disk of rubber shall act upon corresponding diameters of the cone, and thus move it with corresponding velocities. In this manner, the number of

revolutions of the cone is made to measure the power transmitted in a given time. Attached to this cone is the usual decimal gearing, and index for counting revolutions.

The manner of adjusting this instrument is as follows: Holding the shaft firmly to prevent its revolving, by means of a strap or lever, we load the pulley to the greatest power it will ever be required to transmit; then so adjust the cone in relation to the sliding boss that the rubber disk presses upon the smallest part, which we will suppose to be three inches; next reduce the weight to one-half, and the pulley will spring back a little, thereby moving the rubber disk to act on a larger portion of the cone; but at this point it should press on a portion of the cone double what it was in the first instance, or six inches in diameter, and the steel piece should be fitted so that this result will be accomplished. A sufficient number of intermediate points should be established in the same manner, so that at all points the ratio between the force upon the pulley and the number of revolutions of the cone shall be the same. The amount of force then is clearly shown by the revolutions of the cone. But the question of time also enters into power. This is obtained by reading the revolutions at certain fixed intervals of time. The velocity of the cone being evidently the product of the weight multiplied by its velocity, its speed is evidently the measure of power. But its speed is measured by its revolutions. The average of its revolutions is evidently, then, the average of the power transmitted by the pulley, or rather by the spring. In obtaining the average of the revolutions, a divisor is required, which divisor must be such as to bring the answer into units of 33,000 foot pounds per minute or horse powers. Let us suppose the pulley to be thirty-six inches in diameter, and that a strain of 1,000 pounds upon the pulley will bring the rubber disk to a point on the cone where the cone will make an equal number of revolutions with the shaft. Each revolution of the cone will then represent 9,424.8 foot pounds. As a horse power in relation to an hour is 1,980,000 foot pounds, the cone will make 210,084 revolutions per hour for each horse power. We gear down in this ratio to one, so that on reading the index hourly the horse power is read off directly in units. In cases where the figures of the divisor are of such a nature as to require inconvenient complication of gearing to apply them, the figures beyond the first two or three may be replaced by cyphers, and the time of reading the index be extended according to the ratio which the subtracted figures bear to the whole divisor.

The great value of this invention is, that, as an instrument, for testing the duty of steam engines, it is altogether free from the objections that have been urged against the indicator. While practically engaged in my duties, as an engineer, I have noticed several errors in the formulas universally accepted by the profession, and have become satisfied that we have much to learn in regard to the steam engine and boiler. I will mention one case where I have observed a serious error in the usual method of estimating the advantage of a cut-off. Some years ago, I had charge of a propeller engine, of about 250 horse power. The boiler was rather small for the engine, and the performance of the boat was not at all satisfactory. My predecessor had been carrying from ten to fifteen pounds of steam, the cut-off was permanently fixed at half-stroke, and he run an open throttle. The steam pipes and parts were of the ordinary dimensions. I concluded to carry thirty-five pounds of steam in the boiler, and throttle so as to keep the steam in the boiler always at this point. On doing so, the speed of the boat was considerably increased, and the coal account reduced far more than any formula with which I am acquainted, would account for.

In the case mentioned, it was impossible to tell exactly the course of this gain, but I soon determined that no reliable results could be arrived at, without an instrument that would average fluctuating powers, and hence the invention I submit to the society. It is not patented, and will not be. I see no reason why it should not be applied to the main driving shaft of all factories, and thus do for the factory engine, what the counter has done for the pumping engine. At the same time it will be an excellent means of deciding on the merits of the hosts of fancy cut-offs and boilers, that claim the patronage of the public, and serve as a sure guide to the factory owner, in regard to the value of his coal, and the ability of his engineer. Where two engines are used to drive, the duty of each can be obtained.

Before closing, I wish to point out a singular error into which Regnault and others have fallen in regard to the changes that take place when a gas expands without resistance. Two receivers, A and B, are immersed in a proper liquid. A has a pressure of ten atmospheres, and B is exhausted. A stop-cock which connects the two, being opened, the gas rushes from A to B. It is found that no decrease of heat takes place. Hence when gases expand without doing work, they do not absorb heat; now it is plain that it is impossible for gases to expand without doing work. In the case mentioned,

the elastic force of the gas is absorbed in giving velocity to its own particles; this causes the heat to fall, the particles being brought to a state of rest again by friction. This friction develops heat, which heat is precisely equal to that absorbed in expansion. The whole furnishes a beautiful instance of the law of mechanical equivalents, with all the operations taking place in an instant of time.

Mr. C. E. Emery drew a diagram of the new indicator on the blackboard, and explained the difference between it and another which has been extensively used in this city.

The Closing Hours of 1868.

The hour for adjournment having arrived, the chairman said, in conclusion: The presence and attention of a large audience prove that the proceedings have been both interesting and instructive. He congratulated the regular attendants upon the satisfactory manner in which they had spent the last evening of the closing year. The pure pleasure derived from these scientific investigations will not be followed by a single pang of regret, since, aside from their usefulness, they produce on the mind itself an elevating and ennobling effect. The good already achieved, he hoped, was only an earnest of what is to follow.

The meeting was then declared to be adjourned to the following Thursday.

January 7, 1869.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

The chairman opened the proceedings by reading the following summary of scientific news:

The Krupp Cannon.

The new feature in this gun which has produced such formidable results, is the enlarged chamber in which the cartridge is lodged. The charge is double that first used, while the ball remains at its former weight of 200 lb. When tested side by side with the 9-inch Armstrong gun, the Prussian proved greatly superior.

Marine Projectiles.

A paper by Mr. Whitworth was read at the last meeting of the British Association, on the proper form of projectiles for penetrating through the water. It gave the results of numerous experiments,

from which the conclusion was drawn that the form of projectile best adapted or penetrating armor-plate under water, is that having a flat head, on account of its being less liable to deflection on striking the water.

Tungsten Steel Magnets.

C. W. Siemens, F. R. S., stated, in a recent letter, that the metal tungsten, mixed in small proportion with steel, increases the power of the latter for retaining magnetism. A horseshoe magnet of ordinary steel, weighing two pounds, is considered of good quality when it sustains seven times its own weight. The famous Haarlem magnet supports thirteen times its own weight. But Mr. Siemens has succeeded in producing a horseshoe magnet of tungsten steel, which will hold twenty times its own weight suspended from its armature.

New Liquid for the Battery.

M. Delaurier uses a compound, consisting of twenty parts of protosulphate of iron in thirty-six parts of water, seven parts of sulphuric, and one part of nitric acid. He finds this most powerful and exciting liquid will attack iron, zinc and other metals, without any evolution of hydrogen or binoxyd of nitrogen.

Leaf Power in Sunlight.

M. Caillet finds that fresh, green leaves, even when separated from the parent stalk, will decompose the carbonic acid in common air by absorbing one atom of carbon and setting free two atoms of oxygen. After being cut into small pieces, they retain this property, but lose it entirely when they are crushed or rubbed. The decomposing action of the leaf requires a temperature of from ten to fifteen degrees, Centigrade.

Trinidad Pitch as Fuel.

A dispatch from the Governor of Trinidad to the Duke of Buckingham describes some successful experiments made on board her Majesty's ship Gannet with a fuel consisting of pitch from Trinidad lake, mixed in certain proportions with pulverized charcoal, and then pressed into bricks. The fuel showed no signs of adhesion to the bars or melting. With thirty-five per cent of this artificial fuel and sixty-five per cent of coal very good results were obtained. However, 4.35 pounds of mixed fuel give one horse power, while of six different kinds of coal only 3.61 pounds produced the same result. The

artificial fuel is sold at one-half the price of coal. Trinidad pitch contains about twenty-five per cent of earthy material, which accounts for its apparently small heating power.

AN ORNITHOLOGICAL RARITY.

A remarkable specimen of the feathered race, seldom seen in temperate climates, has been recently caught on the Italian shore of the Straits of Messini, and sent to the zoological gardens of Naples. It is the *turdus roseus*, or rose-colored thrush, about eight inches long, with a tuft of dark feathers, showing a violet reflection, on its head; the back and breast are a beautiful rosy tint, the wings and the tail brown, and the feathers of the tail striped with white; the feet are yellowish, and the beak a pale red on the upper part and black underneath. The bird is of Asiatic origin, but is often seen in Africa. It belongs to the dentirostral family, and is a great destroyer of locusts.

CURIOSITIES FROM THE SEA.

The fishermen of Wick Harbor, Scotland, lately found one of the shark family entangled in their nets, which measured twenty-seven feet in length. Its pectorals were seven feet long, and its dorsals three feet. It resembled the *Squalus Maximus*, but it had no second dorsal fin. The oil from its liver filled nine barrels. Mr. Frank Buckland lately announced the capture of a tunny, eight feet seven inches long, and five feet and two inches in circumference, requiring six men to lift it out of the van. Also, one sword-fish and several monster sharks of different varieties. A nice little lot, this, for one week's fashionable arrivals from the court of King Neptune.

EXTERNAL APPLICATION OF CARBOLIC ACID.

A correspondent of *The British Medical Journal* says, care must be taken in the external application of carbolic acid over large surfaces, as three cases of poisoning by it have occurred in the workhouse near Birmingham. It was applied in a wholesale manner, in mistake for sulphur lotion, for the cure of the itch. Two of the cases proved fatal.

This item called up Dr. P. Vanderweyde, who stated that recently he had occasion to inject a body with carbolic acid, and by some accident most of the contents of the syringe came over his hand, which pained him very much, he immediately plunged his hand into cold water, and found it an excellent remedy.

Dr. Wright said that sweet oil is an antidote to the poison of carbolic acid, as it absorbs part of the acid, which water will not. He tried this in his own case many times.

THALLIUM AS A MEDICINE.

This newly discovered metal has the property of entering into the circulation and imparting the most offensive odor to the perspiration of the person taking it. Dr. Bunsen was compelled to absent himself from society for four weeks on this account. This very objectionable property will prevent its practical use in medicine. The action of Thallium is similar to zinc and iron. It is a tonic and produces, in large doses, severe headache.

THYMILIC ACID AS A DISINFECTANT.

This compound, an oxygenated constituent of thyme oil, is said to be a powerful disinfectant, and is not, like carbolic acid, objectionable on account of its odor. It may be likewise obtained from the volatile oil of horsemint. Its odor is quite distinct from that of the oil of thyme, and its flavor aromatic and peppery. It is homologous with carbolic acid, and contains ten atoms of carbon, fourteen of hydrogen, and one of oxygen. As an antiseptic, thymilic acid, which is likewise known as thymic acid, and thymol, should be used by dissolving the crystals in about 1,000 parts of water, and adding thereto a little alcohol. If chemistry can furnish a disinfectant so fragrant as to be attractive, it will lead many to use a safeguard against disease, who generally pay no heed to the most solemn warning of the dangers which lurk in an impure atmosphere.

PRESERVATION OF WINE.

Some time since we noticed M. Pasteur's plan of preserving wine, which consists in heating it to seventy-five degrees C., equal to 167 degrees Fahrenheit; the effect of heat being to destroy the germs that lead to zymotic action. In 1866, a certain quantity of wine thus prepared, was shipped on board of the Jean Bart, and, according to Galignani, the result of this experiment was so satisfactory that the commission has proposed and the minister decided that three new trials should be simultaneously made; the first on a quantity of thirty-one barrels on board the Sibyille, which is about to circumnavigate the world, under the command of Captain Brosselet; the second on 70,000 litres of wine heated in the presence of the commission, and to be sent over to Gaboon, and the third, 100,000

litres, to be shipped to Cochin China. The sailors, who are in the habit of finding wine turn sour under the influence of the sea, watch these experiments with intense interest, as tending to improve the health of the crews during long voyages. This item called forth considerable discussion.

Dr. R. T. Hallock stated that if cider is boiled it will keep for a long time, but its taste is not improved.

Dr. J. V. C. Smith related the case of a large wine manufacturer of New Jersey, who, on the occasion of his daughter's marriage, resolved to have the best of wine provided for the guests. So he came to New York and arranged with a noted importer of wine for the desired quantity, but it was afterward proved that the wine he had bought was his own manufacture, branded as an imported article. Some years ago, the attorney-general of Massachusetts, told him of a case in which a wine manufacturing firm had quarreled, and his legal services were required. The gentleman of the firm who came to him, told him that he manufactured in Sudbury street, Boston, a large quantity of wine, which was bottled and sent to France, where the corks were burnt with the requisite brand, and then the bottles were re-imported, and sold here as genuine French wine.

Dr. P. Vanderweyde said that the statistics show that there is more wine imported to this country than is made in France. There is a certain kind of wine which is much improved when transported a long distance by sea, and again other kinds will become sour.

Dr. J. J. Edwards stated that there were some kinds of wood that give wine a good flavor.

The chairman said he would advise persons requiring brandy for medical purposes, to purchase that made in California, as the grape there is very abundant and cheap; and there the temptation to adulterate is not so great as here.

Dr. L. Feuchtwanger remarked that while in California in 1862, he observed the mode of making brandy there, and was satisfied that they used too much sugar in its manufacture.

Dr. P. Vanderweyde stated he had analyzed some of the manufactured California wine, and did not find it very good.

Dr. J. J. Edwards said he thought the wine of California one of the most useful tonics that can be found. In the time of Queen Elizabeth wine was so valuable that it was dealt out in drops, and it had a wonderful effect; now it is taken by the tumbler full and of course produces a very different effect.

Painting Zinc.

Dr. Bottger claims to have overcome the difficulty of making paint adhere to zinc, arising from the rapid oxydation which occurs on exposure to air and moisture. He makes a solution of one part of chloride of copper, one of nitrate of copper, and one of chloride of ammonium in sixty-four parts of water, and one part of commercial hydrochloric acid. This solution acts as a mordant. It is spread with a wide brush over the zinc, which immediately becomes of a deep, black color, forming a basic chloride of zinc, and what he calls an amorphous brass. The black color changes in the course of a day to a gray, and upon this gray surface any oil paint will dry and give a firmly-adhering coat. Summer heat and winter rain or sleet will have no effect in disturbing this coating, which affords complete protection to the zinc.

Crystallized Tin-foil.

In France and Germany there has been a great demand for paper covered with crystallized tin-foil and coated with varnish, which is used in ornamenting boxes. Puscher of Nuremberg, publishes the following process for producing a crystallized surface on the foil: A solution is made by dissolving two parts of chloride of tin in four parts of hot water, and to this adding one part of nitric acid and two parts of hydrochloric acid. Into this solution the foil is dipped and left until the crystals appear, or the foil may be brushed over with the liquid to effect the same purpose. As soon as the crystals appear the foil must be rinsed in cold water, or its surface may be well washed with a soft sponge. The crystals are small and brilliant when the solution is applied to the cold tin; but when large crystals are desired it is essential to heat the foil, by spreading it on a hot plate, before applying the solution. After being rinsed, the foil is attached to paper and covered with a colored varnish or with gelatine.

Bleaching Flax Fiber.

M. Kolb, in a memoir to the French Academy of Sciences, gives the results of his researches upon the bleaching of tissues, chiefly of flax. He has shown that the gummy substance which adheres to flax, and passing under the name of resin, gum resin, saponifiable matter, &c., is nothing else than pectose. The soaking or steeping of flax determines the pectic fermentation, and the pectic acid resulting remains fixed in the flax, either mechanically in this form, or

partly as pectate of ammonia. This acid being weak, the alkaline carbonates, when cold, act very feebly upon the fiber, but boiling will transform the pectic into metapectic acid, and then the action of the carbonates is as energetic as that of caustic alkalies, with this advantage, the fiber is not weakened. Lime, even when cold, impairs the strength of the fiber considerably, and boiling with caustic soda is much more destructive. Having proved the existence of pectose in unsteeped flax, and pectic acid in the same flax after steeping, Kolb calls the attention of chemists to pectic fermentation, doubtless before known to them, but now of high importance from its industrial application.

Antidote to Phosphorus.

The fact that the vapor of turpentine prevents the ignition, and even the phosphorescence of phosphorus, has been made of practical use in a match factory at Stafford. The workmen who apply phosphorus to the matches carry on the breast a tin cup containing turpentine, and are thus protected from that dreadful disease of the bones which sometimes attacks those who handle phosphorus.

Spurious Gold Dust.

For nearly two years past small parcels have been sent, from time to time, to the United States mint in New York, for coinage, which prove to be small flattish grains of platinum, alloyed with copper and silver, and sometimes coated with gold. Platinum being of greater specific gravity than gold, enough of a lighter metal is added to give the counterfeit the required weight. When coated with gold, the grain must be boiled for an hour or more in a mixture of hydrochloric and nitric acids to remove the coating and expose the platinum. It is believed that this counterfeit is manufactured in France, and sent through Mexico into the gold regions of this country.

Electric Pyrometer.

The method of measuring very delicate changes in temperature by means of the thermo-electric current, generated when two different metals or alloys are united and exposed to such temperature, has been modified by M. Bequerel so as to measure the highest effects of fire. He takes two metals, which resist the action of all artificial heat, except that of the hydro-oxygen blow-pipe, and forms a thermo-electric couple, and to the galvanometer he attaches a graduated

scale. Considerable difficulty has been heretofore found in obtaining reliable measurements of high heat with the ordinary pyrometer, in which the index finger is moved by two rods which expand at different rates when exposed to the same degree of temperature. The rate of expansion of the same metal is not regular from the lowest to the highest heat, and after being exposed to the highest heat it does not always return to its original size when cold. It is hoped that the plan of Bequerel will furnish what has long been wanted, a reliable instrument for measuring very high degrees of temperature.

Dr. Vanderweyde here said there is a great want of a thermometer that will measure high temperatures, say some 2,000 degrees. He found that an iron rod, when heated to a high temperature, will not come back to its original place, and it has to be set every time it is used. Bismuth and antimony, when used for this purpose, will melt at some 600 degrees. But the use of platinum is very good, and promises to become a reliable indicator of high heat.

SILICON IN IRON.

Dr. Phipson, of London, announces that he has discovered that silicon may exist in cast-iron, like carbon, either in a state of combination or in a state of diffusion merely in the form of graphite. Three or four per cent of free silicon may exist in the iron without materially preventing its conversion into good steel by the Bessemer process, but a much smaller quantity of combined silicon will either render the iron containing it incapable of being converted into steel, or will cause the steel produced from such iron to be so hard and bad as to be incapable of being worked. The position taken by Dr. Phipson, if tenable, is one of great interest to commercial steel manufacturers. He promises soon to publish a full account of his method of determining whether the silicon in a given specimen of iron is in a free or a combined state.

THE TELEPHONE.

Dr. Vanderweyde exhibited a "telephone," invented by Mr. Kirpath, of Troy, N. Y., by which musical sounds may be transmitted. A cylindrical box, over one end of which a diaphragm of bladder was stretched, was provided with a speaking tube. In the center of the diaphragm was placed a small piece of platinum. This platinum was in full connection with one pole of a galvanic battery, by means of a wire attached thereto. The other pole of the battery connected with

a point which was placed above the piece of platinum, almost, but not fully in contact with it. When a sound was made in the tube, the vibrations of the diaphragm brought the piece of platinum in contact with the point as many times as there are undulations necessary to produce that sound. This instrument was connected with a straight-bar electro-magnet. When the connection with the battery was made the magnet lengthened, and when it was broken the bar returned to its original length. As this took place, for every vibration of the diaphragm there was a corresponding vibration in the sounding-board on which the magnet was placed, giving a tone which corresponded to the one originally sounded. After the examination of this interesting apparatus the meeting adjourned for one week.

January 14th, 1869.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

The chair presented the following interesting scientific items:

Dangerous Artificial Saffron.

A compound used for tinging vermicelli, and made by Mr. Mittensweg, of Poblitz, has proved to be explosive. The substance ignites as easily as gunpowder. Mr. Chevallier, of the Societe d' Encouragement, Paris, has so far not been able, by analysis, to discover its composition.

Adulteration of Tin.

A report has been published on the quality of the tin coating the cooking vessels used in the French hospitals. The metal used for tinning was found to contain from twenty-five to fifty per cent of lead. In vessels said to be made of pure block tin, the commissioner found fifteen per cent of lead. This amount he believes to be dangerous to the public health, and recommends the government to fix the limit of the amount of lead to be used with tin, in any culinary or drinking vessel, at five or six per cent.

Alcohol from Lichens.

Iceland moss, found in Sweden in large quantities, contains starch and cellulose, which, by means of dilute acid, may be converted into glucose or grape sugar, some specimens yielding as high as seventy-

two per cent. This sugar, on being fermented and distilled, yields a brandy having a very agreeable flavor.

Remedy for a Vine Disease.

A French consul in China has communicated to his government the fact that the Chinese employ a remedy which seems to be effectual in preventing and removing the new vine disease, said to be due to a peculiar insect. They coat the bark and stems of the vine with a mixture of flowers of sulphur and aluminous clay, formed into a thick paste. Sulphur has long been used in this country for diseases of plants, but it has generally been applied alone by means of a hand-bellows containing flowers of sulphur.

The Position of Mines.

The highest mine in the world is the Potosi silver mine in the Andes of Peru, which is 11,375 feet above the level of the sea. The deepest mine is the new Salz Werk, a salt mine in Westphalia. It is 2,050 feet below the surface of the ocean. The average depth of the coal mines of Great Britain greatly exceeds that of a like number of any other kind of mines in the world.

Importance of Life Boats.

The Life Boat Institution has 189 life boat stations on the coast of Great Britain and Ireland. In eleven months of last year 697 lives have been saved by their means, raising the grand total to 17,684. Mr. Jeula, Secretary of the Statistical Committee of Lloyds, has compiled tables which show that the wrecks and casaulties on the coast of the United Kingdom during the past year, exceed by about three per cent the average of the previous eight years.

A New Mode of Causing Death.

A startling discovery has been made by Prof. Casturani, the celebrated occulist of Turin. He has found that by forcing air into the eyes of animals and pressing the brain, they will be killed in a few seconds, and, it is thought, without much pain. At the Royal Veterinary School, four rabbits, three dogs and a goat were killed in this manner within a few minutes. There is said to be no outward trace of injury left by this method; but as it is, evidently, not easy of application, for an air-tight covering must first be fitted to the skull, around the eyes, human life is not endangered by this invention.

Photographs in Tombstones.

The English correspondent of the Paris *Moniteur*, in noticing the fact that photographs of deceased persons are now often inclosed in their tombstones or vaults, adds that when vitrified photographs are more attainable, the use and availability of this practice will be more apparent.

New Material for Bricks.

Ashes and cinders, under the name of breeze, have been employed as components of certain kinds of London bricks, but Dr. Wagner now proposes to make bricks almost entirely of ashes and coke. His process consists in mixing ashes with coke broken into small pieces, and afterward adding ten per cent in weight of slaked lime, with sufficient water to make the mass plastic, which in a day or two will have the proper consistency. The bricks are moulded under considerable pressure and then placed in the open air to dry. In about fourteen days they are ready for use. It is claimed that such bricks are useful in making light dry walls.

The Preservation of Eggs.

The plan extensively employed in Paris is to place the eggs in wire baskets, each holding about a dozen eggs, and plunge them into cauldrons of boiling water, where they remain for about one minute. Thus a thin layer of egg coagulates on the inner surface of the shell, and prevents that passage of the oxygen of the air inward which is fatal to its freshness.

New Use of Glycerine.

When constant temperatures above the boiling point of water are required, M. Vogel recommends the use of glycerine in place of the oil bath. Glycerine of 1.25 density boils at 128 deg. Centigrade, or at between 262 deg. and 263 deg. on the Fahrenheit scale. A mixture of glycerine and water in equal parts boils at 102 deg. C., or between 215 deg. and 216 deg. F.; three parts of glycerine with two of water boils at 106 deg. C., or 222.8 deg. F.; seven parts of glycerine with four parts of water boils at 109 deg. C., or 222.2 deg. F.

Dr. L. Feuchtwanger exhibited specimens of apatite, and then read the following paper:

Apatite—Its Importance in Domestic Economy.

Apatite is a mineral phosphate of lime, similar in character to the bones of animals. This mineral phosphate is most essential to various kinds of vegetable growths, it being taken up from the earth and assimilated as one of their essential elements.

The mineral part of the bones of animals consists to a great extent of phosphate of lime. It must, therefore, naturally play an important part in agriculture; and, indeed, such for ages has been the general impression. Burnt bones lose by calcination one-third part of their weight. This consists of organic matters which is destroyed by the process of combustion. The residue is phosphate of lime, with from ten to twelve per cent of carbonate of lime, and a little fluoride of calcium and magnesia. Apatite, on the other hand, contains ninety per cent of phosphate of lime. The residue is chloride and fluoride of calcium. In the Canadian apatite, about five per cent of silica and a small portion of carbon have been found. Burnt bones are much employed in the manufacture of porcelain. They are mixed to the extent of nearly forty per cent with the other ingredients, such as clay, feldspar and flint. The reason of its employment lies in the fact that the phosphoric acid contained in the compound is the vitrifiable element, which, at a high temperature, converts the other ingredients into a transparent enamel. Brazil and other countries, where the hides and bones of animals are of more account than their flesh, supplies the largest number of the latter for fertilizing purposes. Bones are likewise used in the arts for the manufacture of buttons, combs, and also in the production of phosphoric acid, phosphorus, phosphate of soda, and microcosmic salt. A large amount of bones are utilized by exposure to continued steam, which extracts from them all their grease and other organic matter. They are then ground and sold to the husbandman. The supply of bones is altogether inadequate to the demand, and in order to make up this deficiency other sources of phosphate of lime have been sought out. Guano, or *huano*, as it is termed in the language of the Peruvians, which consists of the accumulated and altered excretions of certain kinds of sea fowls, was discovered in the hot climates of Africa and Peru some thirty years ago. It found a ready market in France and England. Coprolites were also found in large deposits, they proving to be the exuviæ of animals of former times, or, in other words, the fossil excrements of extinct animals. They contain about sixty per cent of phosphate of lime. The crystalline mineral phosphate of lime, or apatite, is found in nature in large

quantities, especially in Norway, Sweden, Spain, Canada, and also in other localities. It has, of late years, been eagerly sought after to supply the great demand for phosphates as fertilizers.

It is, however, well known that neither bone, coprolite, nor apatite is applied to the soil in its insoluble state, being, in that condition, comparatively useless as regards the nutrition of plants. In order to render them fit for agricultural purposes, they must be converted into the soluble superphosphate. In order to effect this, 100 pounds are treated with sixty-three pounds of oil of vitriol. The soluble superphosphate of lime is obtained, which product is generally employed for fertilizing lands.

The quantity of superphosphate of lime at the present day manufactured in England, the United States, France and Germany, is said to be 1,000 tons per day. This rate of production, at an average price of forty dollars per ton would amount to the sum of $14,000,000 per annum. It is now well known that the guano supply is gradually diminishing. We make no doubt that, with the increase of population and the extended cultivation of barren and worn out soils, the demand for superphosphate of lime will reach at least $20,000,000 per annum. This shows the importance of utilizing nature's gifts to their fullest extent. The consumption of superphosphate of lime, in place of other substances used in the arts, is now comparatively small, but may, at no distant day, find a large application in the manufacture of phosphorus and phosphate of soda. A few years ago there was a good deal of inquiry made for phosphate of soda for the use of distillers, whose experiments proved that an addition of it would not alone accelerate the process of fermentation, but also produce an increase in the yield, and it is the main ingredient in Prof. Horsford's baking powder, so well explained in his last lecture before the American Institute. Some fine crystals of phosphate of soda were obtained from Canadian apatite; nor is there any reason why phosphorus, not yet manufactured in this country, but imported from Germany and France to the value of $100,000 per annum, should not be obtained in this country from the native mineral.* In the manufacture of phosphorus the mineral apatite is first converted into a super-

* Phosphorus had been already discovered in 1669, by Brand, in Hamburg. Boerhave, in 1753, tells us how to produce fire in a cold body solely by exposing it to the air. He stated that there was nothing more remarkable, setting gunpowder aside, than that a body should be produced, which though cold, like all other things when kept from the air, is no sooner exposed thereto than it takes fire and emits flames, without the mediation of any other body, or without mechanical attrition or application of fire to it.

phosphate, then mixed with plenty of charcoal, and volatilized at a high heat. Phosphorus is the resulting product. It is used in the manufacture of friction matches, and also for the extermination of vermin. The phosphoric nodules from the lower silurian rocks of Canada, and the coprolites found in the fossiliferous rocks, are all of organic origin, and contain phosphate of lime in various proportions ranging from fifteen to eighty-five per cent. These nodules contain, frequently, fragments of small shells; such sometimes present a spiral or other form of interior structure derived from their animal organization. Coprolites were first noticed by Buckland on the English coast, but are now found in many other localities. They are used solely in the making of superphosphate of lime; while apatite containing a uniform percentage of phosphate of lime, bids fair to compete with the other substances already mentioned in the manufacture of the various chemical compounds.

The superphosphate of lime obtained from the native phosphate of lime, forms the base of various manures, which, if well prepared, cannot but prove highly beneficial, as the sure means of communicating phosphoric acid to the crops. They consist essentially of superphosphate and sulphate of lime, with more or less undecomposed bone phosphate and free sulphuric acid. When this compound is scattered on the surfaces, it remains unaffected until rain falls upon it, when it dissolves and trickles or soaks down into the soil, meeting here with its constituents (lime and potash), depositing here and there a particle of bone phosphate, until the whole soil is filled with the precious fertilizer. The superphosphate, as stated above, is prepared from the apatite, eupychroite, phosphorite, coprolite and phosphatic nodules, and also from bones, in which case it is called bone phosphate, because it contains the earth ingredient of bones. The phosphoric acid is mostly combined with lime in all the genuine guanos. According to the quantity of acid all these materials contain, their market value is determined. A good superphosphate ought to contain, according to Johnson, from twenty to twenty-five per cent of phosphoric acid, partly soluble and partly insoluble in water, and some ammonia or ammonical salts. The soluble part is for quick and energetic action, while the insoluable phosphoric acid renders its effect more lasting.

Guano, which, as well known, is formed from the excrements of sea gulls or fowls, pelicans and cormorants, and found in the torrid zone of this continent, consists essentially of phosphates, but more or less

intermixed with other mineral or organic matters. On many islands in the Carribean sea and South Atlantic ocean, as also in the Pacific ocean, large deposits of from fifteen to fifty feet in depth have been discovered, composed of the rock guano. Nevassa, an island which every traveler to California passes, has produced over 100,000 tons of guano; Sombrero, a coral island, lying in 18° 36′ N. latitude, and 63° 27′ W. longitude comprising about 100 acres, contains the guano disseminated in veins through beds of limestone in inexhaustible supply. The Swan and Baker islands have furnished large amounts of guano, brought into market under the name of Columbian rock guano. These all contain phosphoric acid combined mostly with lime, but also with other bases, such as alumnia or iron. The Sombrero contains forty per cent of phosphoric acid and thirty per cent of lime, with a small amount of ammonical salts. The Peruvian guano contains less phosphoric acid (only ten to eleven per cent), but fifty per cent organic matter, and sixteen per cent of ammonia. Some of the Baker island guano contains even eighty-three per cent of phosphate of lime.

All the guano from the Carribean sea, and coming from Mexico or the Atlantic coast, is frequently called Mexican guano, although Columbian guano is more proper. They all vary from twenty-five to fifty-five per cent in their amount of phosphate of lime. The South Carolina phosphate, discovered in 1866 by Dr. Ravenel, is found in two layers, one underlying the other from two to three feet, the upper layer is quite near the surface. Bones and teeth of large marine animals have been found in the strata, and the guano gives by analysis sixty-five per cent of phosphate of lime and nine per cent of carbonate of lime, and some organic matter.

The Nevassa guano contains not only phosphate but also carbonate of lime, according to Dr. Liebig of Baltimore, who is manufacturing a phosphatic manure from the Nevassa guano, and contains 6.27 per cent carbonate of lime, with 63.55 per cent bone and phosphate of lime.

The Bolivian guano contains 63.61 per cent of phosphates and 11.36 organic matter and ammonical salts.

The Cuban guano is in caves in the island of Cuba, and contains 68.11 per cent phosphate of lime, and nearly ten per cent organic matter.

The Alta Vela guano, situated north latitude seventeen degrees and seventy-two degrees west longitude, eighteen miles from St. Domingo, contains sixty per cent phosphate of lime.

The Malden island guano of the South Pacific ocean contains seventy-six per cent phosphate of lime and fourteen per cent organic matter.

At the conclusion of Dr. Feuchtwanger's paper, Dr. J. J. Edwards remarked that more than half the land in the south is worn out land, and it is very fortunate that this apatite is so very abundant there.

Dr. D. D. Parmelee said that the high price of apatite will prevent its general use for manufacturing phosphates. Our inability to obtain suitable crucibles, is a bar to our manufacturing phosphorus and other compounds with any degree of economy. We make very good plumbago crucibles, but we have no very good ones of other substances. It is surprising the amount of phosphorus that is made in Paris and England. It is now sold at a dollar a pound in this city.

Dr. Vanderweyde remarked that the outside of a grain of flour contains the most phosphate. Those who study much should eat oysters and other shell fish, as they contain a large amount of phosphoric acid. The hypo-phosphate of lime is now much used for consumption.

Means of Transit between New York and Brooklyn.

Mr. J. K. Fisher remarked that he had seen it stated that the Brooklyn suspension bridge was to be 133 feet high. He would prefer a tunnel to a bridge across the East river. A tunnel under this river could never be a useless structure, even in the event of having the river filled up, as some propose.

The chairman said that it was feasible to build a bridge across the East river which would not materially interfere with navigation. Let the bridge at the east end be on a level with, or slightly higher than Brooklyn heights, and continue at that height for about 400 feet to a pier; from which point the bridge might be built on a gradually descending grade, until it reached John street on the New York side of the river. The construction of four, or even five, piers to sustain this bridge, would not obstruct the river as much as it is already obstructed, by narrowing it by docks opposite Grand street. Under the most elevated part of this bridge, near the Brooklyn side, all the largest steamers navigating Long Island sound could pass at all times, while ordinary steam tugs could pass under this bridge at about its central span. A draw could be placed in the bridge to

accommodate a few ships that go to the docks above it or to the navy yard. Large warehouses might be constructed on either side of this bridge, opposite to and connected with the piers, which would greatly accommodate shippers, and the rent of which would go far toward paying the interest on the cost of such a bridge.

It will be remembered that the first plan for a truss bridge over East river was exhibited and explained before this association by Mr. Alfred P. Boller. (See Transactions for 1866–67, pp. 893–907.)

Should the plan for making a ship channel from Jamaica bay to Flushing bay on the Sound, as proposed by the chair at a former meeting (see Transactions of 1867–68, p. 847), there could be no objection to having a number of bridges between New York and Brooklyn. The vast area of land, on the Brooklyn side, within ten miles of our City Hall, which is still unoccupied, would accommodate several million inhabitants; but it will not be occupied by men doing business in New York, unless it is made more accessible by means of bridges.

Dr. J. J. Edwards said: The subject of piers and bridges in the East river had been discussed lately, with ability, by a writer in the *New York World*. In the year 1900 this great metropolis will have 5,000,000 of inhabitants, if we include those in the suburbs of New York; and some provisions must soon be made for the great increase of population on the other side of the East river. If this river was closed, or nearly so, there would be a great addition to the area of "made land." In this event the Harlem river could be deepened, so that ships could find their way from the North river to the Sound.

After further discussion, it was decided to resume this subject at the next meeting.

Adjourned.

January 21, 1869.

Professor S. D. Tillman, Chairman; Mr. C. E. Emery, Secretary.

The chairman read the following notes on science:

Leather Collodion.

Carbon prints are now made by some French photographers on what is technically called "leather collodion," consisting of collodion films to which strength and elasticity have been given by the addition of castor oil. These films are so extremely thin as to permit exposures

through them, and thus the most troublesome part of the carbon process, "the transfer," is dispensed with.

COMBUSTION.

H. Deville confirms the statement of Dr. Frankland, that when gas burns under high pressure the combustion and temperature are increased, and he explains this by his published theory of "dissociation." When hydrogen burns in ordinary oxygen there is never more than half combustion, even in the hottest part of the flame, because the dissociative tension of watery vapor resists it. By increasing the pressure we diminish the influence of this tension of dissociation; hence, increased combustion.

GOITRE.

It is stated, in a paper sent to the French Academy in competition for the prize of medicine, that out of 300 communes in Haut-Savoy there are hardly ten in which goitre is not endemic. Three causes are assigned for this sad condition of the people. First, the use of drinking water containing metallic salts; second, drunkenness; third, want of cleanliness. The authorities have lately attempted to protect the children from the disease, by introducing purer drinking water, and administering lozenges containing the salts of iodine.

THE PHILOSOPHY OF TEA-MAKING.

The *British Medical Journal* says the results of the investigations of careful experimenters are hardly, perhaps, sufficiently known to the multitude of tea-drinkers. The whole subject is carefully summarized by Dr. Letheby in his recent Canton lectures. There is a popular notion, which is an incorrect one, that soft water is best for tea-making. As a matter of fact our London water, which has about five degrees of hardness when boiled, makes the best flavored tea, provided it be allowed to stand upon the tea sufficiently long. Boiling tea is one of the follies of which officials in workhouses and other large establishments are guilty. This makes a deep-colored solution containing worthless extractive matter, which is devoid of physiological or dietetic property. In point of strength it is found experimentally that infusions of tea and coffee are strong enough when about two and a half teaspoonfuls of tea or two ounces of freshly roasted coffee are infused in a pint of boiling water. From some inquiries which Dr. Edward Smith made into the relative

average weights of a spoonful of different kinds of tea, it is to be inferred that the quantity of black tea used as compared with that of green is as three to two.

A New Photometer.

The instrument described by Mr. Roger Wright, before the Royal Society, consists of a smooth metallic rod standing on a heavy base. The rod is graduated from a zero point at the base, and the top is painted white with a black spot in the center. Over the whole length of the rod is a closely fitting sliding tube blackened on the inside. To ascertain the strength of diffused sunlight, the observer looks steadily at the black spot, at the same time drawing the tube upward. When the spot has entirely vanished in the gloom, the observer notes the distance at the bottom of the tube from the zero point as shown by the scale, and this is the measure of the intensity of the light. This photometer, like others made on the same principle, depends on the accuracy of the observer's eye, and the same instrument should therefore always be used by the same person.

The Transit of Mercury and its Apparent Elongation.

At a recent meeting of the Royal Astronomical Society, in London, Prof. Airy said he believed the last transit of Mercury, had been better observed at Greenwich than anywhere else, for there six telescopes were brought to bear upon the phenomenon. Mr. Stone was stationed at the great equatorial. Just before the last contact he saw the phenomenon known as "the black drop," an apparent elongation of the disc of the planet in the direction of the limb of the sun. This phenomenon is caused by irradiation; and he thought it might be explained by drawing a diagram, representing, by two curved lines, the real and the apparent limb of the sun, as enlarged by irradiation. Touching the inner curve, draw a small circle representing the true disc of Mercury, and within this a smaller circle representing the planet as it appears when diminished in size by irradiation. Now when the real edge of Mercury touches the real limb of the sun, as thus represented, there is not light enough left at that place to produce irradiation, because of the cusp that is formed; consequently, there is an apparent elongation of the planet, which may be represented by drawing a line from the outer circle to the outer curve, which shows the direction of the black drop. In past years, people were very much perplexed by this phenomenon, and his own early idea on

the point was that observers used very bad telescopes; but he soon had to give up that theory. Irradiation is probably a purely occular phenomenon, having its seat in the eye itself, and will, therefore, be unavoidable to the end of time.

After the item on "goitre" was read Dr. L. Feuchtwanger remarked that it was said that the mountain air and the water of Savoy was the cause of goitre.

Dr. A. Preterre said that goitre is mainly confined to females, therefore it is not due to the water or the mountains.

Dr. J. J. Edwards stated that goitre is an enlargement of the thyroid gland. It is nothing more or less than a vice of scrofulous connection, by marrying within the forbidden degree. It is one of the most simple forms of scrofula. Whenever blood relations marry there will be scrofula in some shape or other.

Dr. L. Bradley said he always understood that goitre was occasioned by drinking the sandy water of the Alps and other mountainous places in Switzerland.

New Kerosene Burner.

Mr. Bliss exhibited his kerosene lamp. The chimney is four inches high, and gives perfect combustion. A six inch chimney would increase the flame just one inch higher. The chimney is always cool, the air is admitted so evenly that it cools the burner so that the chimney can be taken off after some time.

Results of Chemical Action in a Boiler.

Mr. C. E. Emery exhibited some pieces of zinc taken from a boiler; they were placed on the upper surface of the water; they were put in the boiler to prevent corrosion of the iron. The first surface condensers were made with copper tubes, and the effect was that the heating surfaces of the boiler were covered with pin holes. The same difficulty occurs now where the tinned tubes are not perfectly tinned. Zinc was tried, and the result is to curve the zinc in this curious shape. They have been placed in the boiler five months. The zinc when put in was in square straight pieces, and now they are quite curved, these curves are probably due to the rapid circulation of the water, the convection is toward the fire door surface. The water used in this boiler was distilled, that is, condensed steam. Pure olive oil was used in the cylinders. It is an important item to save water for boilers in this city, where the water tax is so great;

for this reason in some cases the steam is condensed, and used over and over again.

FUSE FOR FIRING NITRO-GLYCERINE.

Dr. D. D. Parmelee exhibited specimens of the fuse in general use in exploding nitro-glycerine. It is Mr. Bishops. The fuses are primed with the mixture of the subphosphide and subsulphide of copper with chlorate of potash, in which the terminals have not been found quite free from adherent residue after ignition. The fuse is ignited by a static electric machine which works in damp weather. The disk of the machine is made of India rubber. Where a number of explosions are required, the wires are alternately connected with the positive and negative poles of the battery.

The electrician of the Hoosic tunnel exploded several primers, and in one case he exploded four together, the report of which was simultaneous.

AN OLD PHOTOGRAPHIC CAMERA.

Mr. John Johnson exhibited a camera which was used some thirty years ago. He also showed one made in 1839, a year later, which was used in London to take pictures. At first, a concave mirror made of speculum metal, was used; this simply inverted the figure, but did not change the right from the left. An objection to the speculum was its high price, a good one costing $100; but the concave mirror, here used, invented by Mr. Walcott, could be made for about ten dollars. In 1840 he went to Londom and patented this camera there, just one year before it was patented here. The first cameras were of twelve inch focus, which was soon after reduced to six inches, which made a picture in just half the time. With short focus cameras, there is a difficulty in getting the chemical focus; a tape was sometimes used to measure the distance from the sitter to the camera, and then to place the index hand to that measure on the scale attached to the camera. He only presented this camera as a specimen of the first used in this country, and on account of its good order and preservation. He first used the chloride of iodine on the daguerreotype plate, and afterward the chloride of bromine, which quickened the process materially.

BRIDGES TO BROOKLYN.

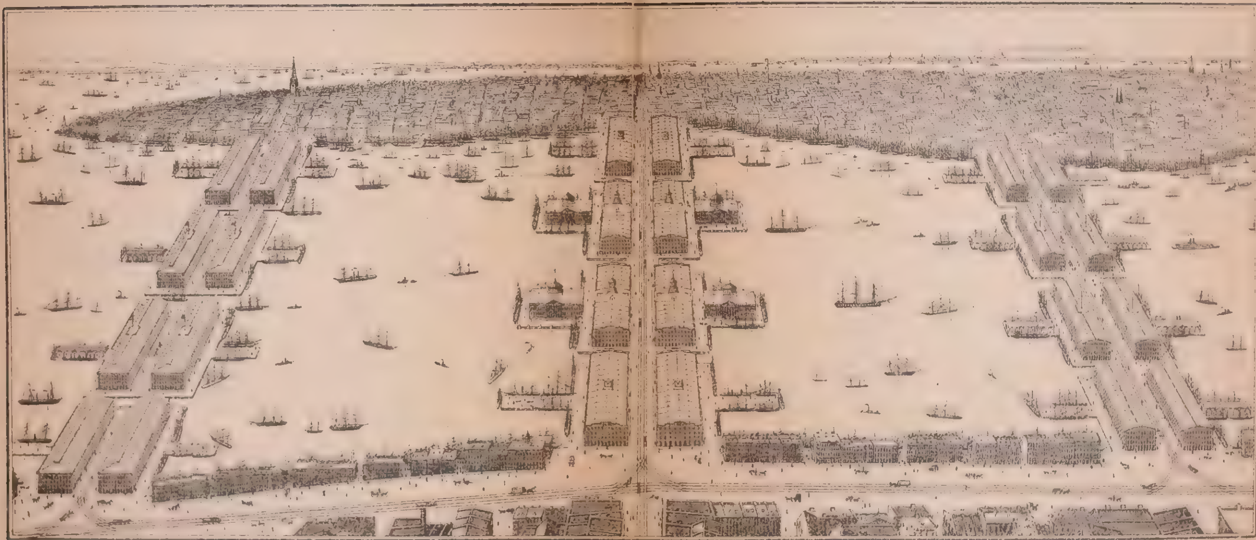
Mr. Fisher made a diagram on the black-board, of the suspension bridge, to start from Tryon Row, the ground here being thirty feet above high water in the middle of the river.

Mr. George W. Dows read the following explanation of his plan of making dykes, and wet-basins in the East river. He also exhibited a drawing of the plan.

This plan, for making docks and wet-basins in the East river, which has already been noticed in some of the daily papers, offers a feasible and noble provision for the now great and rapidly growing wants of New York and Brooklyn. Its object is to furnish superior anchorage and wharfage for the shipping, large and convenient warehouses for merchandise, and handsome stores for jobbing and retailing purposes; also, solid, pleasant, *free*, and abundant passage way for pedestrians, and all kinds of wheeled vehicles, between the two cities, doing away with the ferries, and all necessity for bridges and tunnels across the river.

In their letter to the Harbor Commissioners of 29th December, 1855, Gen. Jos. G. Totten, Prof. A. D. Bache, and Capt. Chas. H. Davis, among other observations, said: "Among the harbors of the world, none exceed New York, and but few can compare with it in beauty and commodiousness; but, immense as this harbor is, there is a limit to its capacity, and to what may be called its natural resources. Its business cannot much longer be carried on as now, but will require a system of wet-basins, built with materials and upon a plan commensurate with the opulent resources of the State and city, and the stableness of their prosperity. Wet-basins add much to method and dispatch, which are the living principles of business. We are not to govern our views by the New York of to-day but by the New York of fifty or a hundred years hence. Sooner or later, a system of wet-basins must be adopted even here. Into London is poured the wealth of the world, which, but for its docks, must have found elsewhere a place of deposit. They are indeed the means, as well of the symbols, of its commercial greatness."

These gentlemen recommended several places in which to locate such basins within the city limits. Those places having become filled up and otherwise occupied, there is now no other way to fully supply this great want than in the plan here proposed. The Harbor Commissioners said: "It is manifest that the commerce of New York will eventually become greater than that of any other city of ancient or modern times and that the city must become the center of trade and exchanges; the storehouse and metropolis of the commercial world. The experience of the past justifies the assumption that within the next thirty years, New York will surpsss any other city



PLAN FOR BASINS IN THE EAST RIVER, BETWEEN NEW YORK AND BROOKLYN.
by George W. Dows

of the globe in the volume of its trade and amount of its tonnage." Indeed, our growth in commerce and population has been more rapid than was anticipated, and "our sufferings are intolerable" under the present cramped and crowded condition of things. Relief in some way must be obtained, and cannot come too soon. This project will supply all that we need, and its influences in deepening the channel to Sandy Hook, quieting the waters of Hellgate, and otherwise improving the harbor, also strongly recommend it. The "East river," being merely an arm of the sea and not a true river, thus affords such convenient and magnificent docks as cannot be had elsewhere.

It is proposed to occupy the "East river" between Corlear's Hook and the foot of Broad street or Old slip, making two or three large basins, with surrounding warehouses; the sound steamers to be kept on the eastern side of the docks, and accommodations to be provided for ocean steamers on the western side; admitting of all descriptions and sizes to pass through at high tides, or stated periods of the day and night. The wharves and piers are to be faced with stone and filled in with earth, making solid ground for buildings and streets, except at the ship passage ways, which are to be crossed by bridges of forty to seventy-five feet long (the center ones being longest) and 100 feet wide. One hundred feet is the width of the central street, the stores and warehouses, on each side, being 150 feet deep. Five hundred feet is the whole width of each causeway. The signal-flag shows when a causeway is open for passing vessels; the times of opening to alternate, so as always to keep most of the causeways in condition for an uninterrupted intercourse between the two cities.

The cost will be many millions of dollars; but the plan carries with it the true elements of self-construction and preservation, so that no municipal aid will be required. Ferries, bridges and tunnels must have returns in tolls, or taxes on the people at large; but this project looks only to the rents of its wharves, warehouses and stores, which promise to pay a large percentage on the outlay; and already there is evidence of an abundant capital being supplied as soon and as fast as wanted.

Many of our oldest and best informed citizens, merchants, shipmasters and others, have seen and approved of this project, and it now only needs the assent of the proper authorities to insure its construction. As in all great works, some objections and inconveniences may attend this; but it is evident that they can be only

"as a drop in the bucket" in comparison with its many and very great advantages, which would give immediate and permanent relief, and also a powerful impulse to the growth of our commerce and population.

In conclusion, Mr. Dows said he would discuss the question more fully at the next meeting.

Adjourned.

January 28, 1869.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

The usual scientific items were read by the chairman, some of the more interesting of which we note as follows:

Preservation of Eggs.

A mention of the French method of preserving eggs by coagulating a film of albumen upon the interior of the shells by dipping them for a moment in boiling water, called out a suggestion from Dr. Bradley that the shells might perhaps be rendered impervious to air by coating them with hydrated alkaline silicate or soluble glass. To this a member replied that he had tried the proposed method several years ago. He carefully coated the eggs with silicate, packed them in bran, and let them alone for three months. At the end of that time he broke them, and "let them alone for ever after." Dr. Vanderweyde explained that when the silicate is manufactured under a high pressure it will not deliquesce as it will when the alkali is in great excess. Some years ago a bridge over the Schuylkill river was coated with this material to render it fire-proof. The soda washed out and the silica was reduced to a powdered condition, so that the experiment was practically a failure.

Patent Soles for Boots.

As a new and useful invention, Clarke's patent sole for boots and shoes was exhibited and explained. The outer sole is perforated with numerous holes into which are firmly fitted knobs or pieces of India rubber. These knobs project about one-sixteenth of an inch below the surface of the sole, and prevent slipping upon ice, slippery pavements, etc.

Bridge Communication between New York and Brooklyn.

The regular subject for the evening, that of bridge communication with Brooklyn, was then opened by Dr. Edwards, who condemned any reliance upon Brooklyn as affording any accommodation for the surplus population of New York. A bridge to Brooklyn would be of no use, and to throttle the river by bridges or otherwise would only impede the commerce of the city without helping its growth in any way. After Dr. Edwards' remarks, which met with some very unequivocal tokens of dissent from those present, Dr. Lozier explained the construction of the arched suspension bridge invented by Mr. L. W. Wright, an English projector now in this country. The bridge was sketched as consisting of a series of iron ribs, so connected and arranged as to sustain or support the pressure and tension of each other; the ribs being of any desired arch or curvature, or, if desired, nearly level like common girders. It is claimed for the invention that it may be built on piers capable only of sustaining the vertical pressure, the thrust of the arches ordinarily incurred being done away with. It was thought that a bridge on this plan might be thrown over the East river on a single arch, the distance being about sixteen hundred feet. Dr. Rich advocated a plan proposed at a previous meeting by Mr. George W. Dow, of Brooklyn. In this the river is designed to be crossed by several causeways, each from three hundred to one thousand feet in width; the central portion of each one serving as a roadway, while the remainder should be built up with stores and warehouses. Between the causeways large basins would be formed for the accommodation of shipping, to which access could be had by passages through the causeways furnished with locks or gates. Mr. Dow followed with an elaborate paper in defense of this plan, in which the action of the tides and of the North river current with reference to the filling up, or *vice versa*, of the harbor was discussed at considerable length, which is here appended.

Mr. Chairman: At the meeting of this association, on Thursday evening last, the plan for docking and making wet-basins in the East river, and the important objects to be gained thereby, was pretty fully explained, showing how largely and well it would meet the evident and rapidly growing wants of our harbor, our commerce, and our population in general; and that it would also tend to unite the cities of New York and Brooklyn which should be one in name as they really are in fact, and thus do away with disputes respecting the river property, and at once make a city of one and one-half millions

of inhabitants, which, with the facilities of the proposed construction, would soon double in numbers; and the dock improvement in itself would also add many millions of real and taxable property to the wealth of the State, besides giving an impetus to trade which would greatly benefit our whole country.

During the discussion which followed four objections were raised. *First*, that the plan might, if carried into effect, injuriously obstruct and impede the navigation of East river. *Second*. That the water in the basins would be likely to freeze up in winter. *Third*. That the basins would soon fill up with silt, or mud and the out-pourings of sewers; and *Fourth*, that on the law of tidal flowages, a dyke across the East river might injure rather than improve the ocean entrance to our harbor.

For a few moments let us examine these objections, and see if they are not rather the result of fear than of a proper consideration of all the circumstances.

First, as to the supposed serious obstruction to navigation in the East river. The plan itself by the conveniences it offers, does away with all necessity for ferry-boats in its vicinity; and for the eastern steamers and a large portion of the sailing vessels to go round into the North river. Thus greatly lessening the number of vessels which are now going on that part of the river. It also gives such facilities to our larger vessels and foreign shipping, with the ocean steamers that they will gladly seek its aid; and it is evident that not many large vessels will desire to pass uninterruptedly through, except occasionally as now, and when repairs are desired. Of the smaller class, chiefly schooners and sloops in the coal and lumber trade, with some few others, from best information obtained from Hellgate statistics, a large allowance will be 150 sail for one day. This exceeds very considerably the present *average* which is not much if any over 100 sail per day. Many of these vessels are bound to, and from the far east, to ports further south, and might just as well go more directly, and outside of Long Island; but, admitting that they must all go through the proposed docks, we have one-half, or seventy-five vessels at each high tide, and three outlets at each dyke, making twenty-five sail for each outlet, and one and a half to two hours or more at every high tide, in which to put them through. It is easy to see, and our tug-men confirm it, that they can all be put through the first dyke in less than one half of an hour leaving about one and a half hours for any other vessels that may

want to pass in or out. On best authority we find that at least one and one half hours, on an average, passes away during the rise and slack water, and fall of the first half inch, at full tide, and when the motion of the water is scarcely felt. Probably a still longer time could be used, because the high tides will be at the navy yard and at Governor's Island at a different period of time, say one hour or more apart, and when the sails have reached the other end of all the basins (which can be passed regardless of the outside waters, it not being proposed to have any gates on the interior lines), the outside high tide will soon let them through, and thus, probably, not more than two hours will be consumed in the whole passage. If either open flowage of tides, or a system of locks is found to be better than flood gates, they can be adopted. We admit that in either arrangement there would be some delay beyond the time now consumed in passing this part of East river, particularly when free from ice; but it will be more than made up by the stillness of the waters which the dykes will cause at Hellgate and elsewhere, thus enabling vessels to pass on without their present stoppages; so that, in reality, the dykes will hasten, rather than retard the passage of vessels between Governor's Island and Throg's Neck, or Long Island Sound; and in freezing times, they will do them a great additional service by keeping ice away, as will presently be shown. Suppose, however, that there is some delay, and that some of these sloops and schooners are compelled to wait, even a whole day, or go outside of Long Island, or through a Harlem canal, are we to relinquish a vast good which the docks would confer on the many, simply because this comparatively small interest, large as it is, might be put to a little inconvenience? In the language of the Coast Survey, "we are not to forego docks, wharves, and piers, &c. (to which we may add good harbor entrances, and great highways of land travel) "the very means and instruments by which the use of the harbor is established, because wherries and small craft cannot stem the current" (or be put to some delay). No; as well might a man refuse to eat, and preserve his life, because his hand might be put to some trouble in conveying food to his mouth. We should rather seek for the greatest good to the united interest of all concerned and govern ourselves accordingly in these public works.

On the second objection, the liability to freeze, we have only to instance the experience of the Atlantic dock, Brooklyn, to whose superintendent this plan has been submitted; and he says that we need not fear any serious trouble from that cause. Of their own dock

they say: "Ice, which so frequently obstructs the ferries, gives little or no trouble to the basin. That which forms inside is thin, and kept broken and fragmentary by the constant movement of vessels. When the ice is coming in on a flood tide, the basin entrance is temporarily barred by a float, which wards off the ice, and induces it to pursue further on its search for a nook or bay in which to entrench itself." Their depth of water is only twenty-five feet; and when we consider that in the proposed basins the water will be from forty to sixty feet deep, and that the whole body of water, from the surface to the bottom, must be chilled to the freezing point before ice can form on the surface, and that, in the coldest weather, we can prevent that chill, by exchanging the inside water of the docks for the warmer water just brought in from the ocean. It is easy to see that we can always be free from ice, and not even troubled, as now, by the North river ice, which the dykes would keep away entirely.

On the third objection, concerning the silt or mud and sewerage, it is too early at present to say precisely what may be done in this direction. It is pretty certain, however, that this matter cannot be in a much worse condition than it is now in. The slips of New York and Brooklyn are filling up at the rate of one and a half and two feet per annum, and are only kept free by the dredging machines. That a very large portion of this silt comes down from the North river is proved by the fact that at the Cunard wharf in Jersey city, ten feet of mud are dredged out annually. The proposed dykes would shut this off, and a constant high water in the basins would prevent any of the present sewerage stenches of the low tides; and the sewerage stuff could as well be dredged out then as it now has to be, and in many cases at private expense. It is believed, however, that this manure may be retained in tanks, and pumped out and carried off at an expense which the agriculturists will gladly pay for its use; but of one thing we may be sure, that the owners of the docks, in self protection, will not allow the sewerage in any way to injure their property, so the public have nothing to fear from that source. Nor is there the least danger that they will ever allow the basins otherwise to fill up so that they cannot be used.

We come now to the fourth and most important objection: whether these dykes and docks would not cause such effects on the running waters as might injure rather than improve our main channel to the ocean, as has been noticed in the Boston harbor.

It is a fundamental rule laid down on the experience of European

engineers, and acknowledged as just by high authorities of our own country, that "the navigable condition of the channels, at the entrances and over the bars of tidal rivers, especially as to permanence and capacity, is entirely dependant on the influx and efflux of tidal water." In other words, in order to keep your channels good you must preserve the receiving capacity of your inland basins, or tidal reservoirs, so as to keep up the great inward and outward flow of water to scour the channel. We acknowledge the correctness of this rule, and the necessity of adhering to it in all cases where the waters of the flood tides return by the same channel and in full, to the ocean, as at Boston; but it is different where the flood waters largely run off in some other direction, and also cause to run off in that other direction, a large portion of the river's natural flowage, as is done in the harbor of New York. Every one must comprehend that it is not the waters of the incoming tides, but rather the outflowing waters which best clear the channel; and that if more water comes *in* from the ocean, than goes out, the channel is most likely to choke up and be spoiled. Consequently the aim should always be to have the greatest possible flowage *from* the harbor down to the ocean. These premises being acknowledged, let us now examine the flowage of waters between New York city and Sandy Hook, and see if all is right in that direction. The flood tide runs in from the ocean, and up through the East river to Long Island sound, occupying about six hours. Then comes the ebb tide returning from the sound, through the same channels, to Sandy Hook and the ocean, also occupying about six hours. So far all may be well; and, if we had no Hudson river, the rule laid down by European authorities might be perfectly applicable to our harbor; but we have a Hudson river, a deep flowing river, and one which makes that rule decidedly inapplicable, while the East river remains open as now. The peculiar manner in which the flowing waters of the Hudson river affects our channels seems not to have been noticed by the coast survey, or the harbor commissioners, and never to have attracted that attention heretofore which its importance evidently deserves. Indeed this writer has found no mention of it previous to his own observations in that direction, and remarks upon it about a year ago. During all ebb tides the water of the Hudson river flows naturally down to the ocean, passing off with the receding ocean waters in the six hours or so of ebb tides; but on the flood tides an irregularity is discovered. The waters do not then run up the river, above the city,

during the whole six hours or so of the tide. On the contrary, they only flow up there four and one-half to five hours per flood tide, during most of the year; and, for about six weeks time, in early spring, during heavy thaws and rains up stream, there is actually little or no upward tide flowage at all between this city and Albany. Yet the river water, during all the flood tides of this period of time, is continually running down the stream. It does not, however, go down to the ocean at Sandy Hook. When the flood tides come in, all this North river water is compelled to turn its course and pass around the battery into the East river; consequently, all of this vast body of water, which would do so much good, in its outward flowage, by scouring and cleaning out our channel to the ocean, is carried off to Long Island Sound; and there is no recompense in the returning ebb tides. Moreover, the flood tides through the East river, have a velocity of four and eight-tenths to five miles the hour while the ebb tides, at same state of tide, run only about four miles the hour; so that even the tides themselves do not balance each other, the difference being against the ocean channel. These rapid currents are continually deepening the "East river;" and, as the river deepens, the currents flow faster and faster, and the odds against the ocean channel becomes greater and greater every year. We would clear away all dangerous obstacles in our harbor and its entrances; those at Hellgate, of course included. But it is perfectly plain that the East river entrance, at the Battery, while open as now to the North river waters, cannot be deepened and widened without great injury to our Sandy Hook channels. In 1857, it was found that the East river, between the Navy Yard and the Battery, had deepened three to six feet in about twenty years, and, in the "south channel," at Sandy Hook, where there was *twenty-one feet* in 1835, there was but *eighteen* feet in 1848, and only *sixteen* feet in 1853. It may not be that our ocean channels will all be reduced to *sixteen feet* ten years hence, as Captain Brady, of the coast survey, supposes, and we would not adopt his plan of shutting off the East river entirely. Still we must do something in that direction. A mere narrowing of the stream would not answer the purpose. That would only cause it to deepen, as in the narrow places at and near Hellgate, where a depth of 120, and even 140 feet is found; but we must be able to control the East river entrance, and say to the waters when we please, "thus far shalt thou go and no farther." Gentlemen of the coast survey, Professor Bache, and others, have

estimated the flowage of a single tide, between New York and the Jersey shores, at 327,000,000 of tons in weight. Assuming that this is on a full tide of six hours, and that, during the year, at least one-quarter of it is carried around the Battery to the East river and into the sound, we find that there is thus lost from our ocean channel, the weight and momentum of about 82,000,000 of tons of water, *twice in each day*, on an average, during the whole year round; and all this, if of the best flowing water for scouring purposes, and such as can be made to go outward to the sea, causing a far greater *outward* flowage than can be brought *in* by the flood tides.

If it is asked why not let this condition of things go on, and finally make the Hellgate passage the main channel to the city, as it might be made if all obstructions are cleared away; the reply is that our commerce does not all come from the east, and other great and important interests of the country at large would greatly suffer; and besides, an insurmountable objection is found in the well known fact that Long Island sound, between Riker's island and Sand's point, freezes up in severe winters, for weeks and even months at a time. Some gentlemen say that the ice from the North river flows into the sound, and spreads out beyond Throg's Neck in broken pieces, but quite thick, and in considerable quantities, and that the winds and incoming tides from the sound then bring it back to the narrow channel at Fort Schuyler or Throg's Neck, where it is joined together, and chokes up the passage, and the cold weather soon freezes it all into one solid mass; thus putting an end to navigation until warm weather again throws it open. This being so, if we keep the North river ice entirely away from the East river, we shall greatly benefit even the sound navigation, besides that of the entire East river up to our city.

Having discovered that so large a portion of the Hudson river flowage is lost to the Sandy Hook channel, that it is very largely the cause of the dangerous navigation at Hellgate, and that it fills the East river with ice in winter, and possibly aids in the freezing of Long Island sound near Fort Schuyler, we have suggested that a remedy lies in the use of a dyke or dykes across the East river. The proposed dock plan, having several dykes or causeways, is intended to correct the water flowages, and at the same time to keep up the passage of vessels through the East river; and also furnish greatly increased accommodations for our shipping, and all classes of our people; and thus give a new impulse, in an onward course, such as

New York can never attain to in her present crowded, cramped and shackled condition.

The city of London, under the pressure of her growing commerce, found herself compelled to pull down her houses, over acres of land, in the heart of the city, and, at large public expense, to dig up her streets and make her docks, without which she could not now maintain her exalted position. New York already is equally hard pressed for good wet docks, within easy and convenient distance for her merchants, and she has only to say the word, and obtain the assent of our State and congressional authorities, when there will soon spring up, out of the resources of private capitalists, this noble and feasible project, which promises so much good for her harbor and to her people, and such magnificent shipping and warehouse accommodations as will make her the storehouse of the world, and preserve her own preëminence in population and commerce for long ages to come.

At the conclusion of Mr. Dow's paper, Dr. Vanderweyde explained that were it not for the tides the harbor would soon fill up with silt. The closing of the East river would undoubtedly tend to this result, but the greater rapidity induced in the currents through the day would benefit Sandy Hook, etc., by deepening the channel. Whatever convenience might result from the causeways would be more than balanced by injury to the harbor. The speaker stated that in the great majority of cases, the filling up of channels is due to the deposition of silt from river waters. Sea water seldom deposits in this way. He illustrated this by a reference to the filling up of the basins in Amsterdam and Rotterdam, in Holland, while at the mouths of the Rhine and the Iser, in Germany, the channels through which navigation is carried on are salt water channels, answering in their general nature to the East river.

Mr. Lozier presented a diagram of a bridge across the East river, the patent of Mr. Lemuel W. Wright, of England, and read a short description of it.

Dr. J. J. Edwards said, we want all Long Island for a market garden, the same as in London. The course of the North river has been altered by dykes. We want room without disturbing existing rights. We have a magnificent sound, and we want more docks than we have. The Great Eastern can go along side of Morris' dock, just above Harlem on the East river, and a great proportion of our shipping would go there if they could get dockage. The upper part of the island will be the center of the commerce of this city. We have

the Harlem river, but we make no use of it; we should put it to some useful purpose.

Dr. J. B. Rich remarked that any one who has examined the situation of New York, will see at once that a bridge elevated above the water seems impossible. It would involve so much time that it would hardly be worth while to go three-quarters of a mile in the city to get something like a level. A man will sometimes present a project one hundred years before the time; it will be laughed at and hardly any notice taken of it. So he viewed this plan of Mr. Dows. There are many advantages to be derived from this plan; and among them is that of deepening our bay. This bay is well known to be fast filling up, but the moment we cut off the East river channel, the water will be diverted in another direction and clean our bay very effectually. It is the immense alluvial matter that comes down the North river, over two hundred miles long, which strikes against Governor's Island, that throws this matter into the East river, thus choking up the channel there. All the arguments that the East river keeps the channel open, are based upon a false foundation. If the flow of the North river was more rapid, it would clear itself of its many obstructions, which in a short time threaten to fill the harbor entirely up. This plan of Mr. Dow's will quicken the current of the North river considerably. This channel is not filled up from what comes in from the sea, but from the silt that comes down the North river.

Mr. Dudley Blanchard remarked that the Hudson or North river, in the spring, is a very considerable river, but at other times it is not an important river. The water flows up that river five hours, and down seven hours.

Mr. Dow stated that the tide of the East river runs up at the rate of five miles an hour, and down at four miles.

Mr. F. Shelbourne said that most every river that has its outlet into the sea, has more than two channels, and when one is filled up another is deepened. The channel at Sandy Hook has been a thousand feet narrower, although Mr. Blunt denies this.

Mr. C. E. Emery remarked that the tides appear to be a very formidable objection. Now what is the effect of stopping it? It must raise the tide in other places. The flow will be found to be very great up the North river; but this objection can be overcome by having connection with the open sea, and thus shutting off the water. Vessels can be passed in and out at all times.

Adjourned for two weeks.

February 11th, 1869.

Professor S. D. TILLMAN in the chair; Mr. C. E. EMERY, Secretary.

IMPROVED CARPET STRETCHER.

Mr. Charles Ruckert exhibited his carpet stretcher, which acts on the principle of the toggle joint, and exerts immense force. A number of teeth at the end of one of the levers fastens into the carpet, and on working both levers the carpet is stretched very even and tight.

GAS BURNING STOVE.

Mr. John Johnson, of Saco, Maine, exhibited his gas stoves. These stoves, he said, on account of being made of corrugated iron and other improvements, will warm a room sixteen by sixteen feet at a cost of two cents an hour.

IMPROVEMENT OF NEW YORK HARBOR.

Samuel McElroy, C. E., read the following paper on this subject, which is a report made by him some years since.

In November, 1858, while engaged on the construction of the Brooklyn waterworks, I was requested by George S. Howland, Esq., a prominent citizen of Brooklyn, to examine the feasibility of a plan suggested by him, for two or more bridge piers across the East river, to be arranged for the construction of warehouses, and built on blocks and piles, or other open water ways, with draw bridges; these piers to carry wings at right angles, for increased warehouse construction, which was a prominent feature of the design.

My study of this plan made it clear, that while such an arrangement for warehouses would be highly remunerative, there were several objections to open water way bridges across the East river at street grade.

From considerable experience in the naval engineer service at the navy yard, of the contingencies which, both in winter and summer, affect the value of New York harbor as to its channel entrance, Battery and East river anchorage, annual ice gorges and silt deposits, excessive tidal currents and otherwise; and also in view of the increasing demand for an adequate and entirely reliable means of transit for persons and vehicles between New York and Brooklyn, I was led to change the plan suggested by Mr. Howland to a form intended to furnish an absolute relief to the harbor as the first con-

sideration, and to connect these cities in a permanent manner, as a contingent benefit, and to provide the most ample facilities for warehouses and transhipment, as a commercial benefit and a source of direct remuneration, together with the proper tolls on vehicles and foot passengers; and I submitted my views to him to this effect, under date of December 9th, 1858.

This plan, for which a number of notes were collected at the time, has been occasionally alluded to in public prints, though chiefly as incidental to other matters. More recently, in a report made January, 1867, to the Hon. J. P. Goodsell, State engineer, on a "Survey for the improvement of the Hudson river and Champlain canal," it was thus mentioned:

"New York harbor itself, however, has one defect for which engineering science controls a simple and advantageous remedy. The present ship channel at Sandy Hook is obstructed by bars, and is not properly adapted to the requirements of so important a harbor in depth, direction, or permanency; and from Staten Island to the upper part of New York, the Jersey shore on one side and the wharf slips on the other, are places of deposit for the silt of the Hudson river and Newark bay, which enters its lower basin from the west.

"This arises from the peculiar conformation of the harbor, which connects with Long Island sound by the East river, and through the action of the flood tides, which seek this short outlet, the proper volume of the Hudson is diverted from its natural course, its velocity impeded, and its suspended matter deposited at points of great commercial importance, with objectionable results, while the entire East river front of the city is subjected to a continual alteration of powerful tidal currents, which impede the usual operations of commerce and ferry transit, and become dangerous in the winter season by ice fields, diverted from their proper direction and carried around the Battery.

"The remedy for this is to be found in the application of principles which obtain in all similar cases, and which have been sufficiently tested on the same river, as on many others. By shutting off the East river inlet at some convenient point, more directly near the Fulton ferry, or near Houston street, the entire volume of the river supply, represented by a stream of over 800 feet wide, twenty feet deep, and five mile current, would go out to sea and make its own natural and effectual channel, independently of all artificial or temporary aids.

"A good and substantial dyke or pier, about 400 feet wide, with

large ship locks, with the Harlem river improved as a ship canal, would establish the main ship channel at Sandy Hook, with enlarged dimensions and increased depth; relieve the deposits at the city docks and Jersey flats; prevent the tidal current on the East river front, with its obstructions and dangers; connect the cities of New York and Brooklyn, with an adequate means of transit; divert the sound trade to its proper terminus in upper New York on both sides; and furnish facilities for warehouses, basins and docks, which are out of the question now, but are very much needed."

In connection with this subject, the recent action of prominent citizens of Brooklyn and New York, favorable to the construction of a colossal suspension bridge, to be about 5,862 feet long, with 1,600 feet central span, swinging 130 feet above the river, and estimated to cost not less than $6,675,357, shows the public demand for an adequate means of crossing, chiefly superinduced in that case by the hindrances to ferry transit in the winter season from ice fields in the East river, and the desire for more perfect city union.

I have, therefore, revised the notes collated at that time and since, so as to present with some minuteness of detail the distinctive features of the plan proposed, and they are herewith submitted.

Proposed Plan.

This will be discussed as to its General Construction, Location, Cost and Detail Construction, Income, Advantages and Objections.

General Construction.

The general construction is that of a permanent pier, built solidly from the river bottom to the coping level, five feet above mean high tide, from one shore to the other, with a width of 450 feet at the top. This pier to have not less than two guard locks for the passage of vessels of the largest class, up to 395 feet length, eighty-six feet beam, and thirty feet draft, the locks being worked by floating caisson gates, at each end, fitting into large cut stone grooves, and operated in the usual way.

The means of travel over the pier to be by three streets; are thirty feet wide on each side, connecting with the caisson gates, which are fitted as bridges when shut, the third, a central avenue, varying from sixty to 110 feet in width and connecting at the guard locks with a wrought iron double track swing bridge thirty feet wide by 225 feet long. There is also to be a double tunnel, passing from a point near

each end of the pier, under the guard locks, each side being twenty-two to twenty-three feet wide and eighteen feet high in the clear, with five feet sidewalks and a paved carriage-way. For convenience of construction and use, the line of this tunnel at each side of the locks will zigzag in rising on its grade (of about three and one-half feet per 100), while a side footway stair will provide for pedestrians so as to avoid any loss of distance in walking over.

In connection with the tunnel, at the first return near the guard lock side walls, commodious engine and boiler rooms will be built to provide the power required for occasional drainage and pumping, for pneumatic tubes, for working the gate and other capstans and the swing bridge, for tunnel ventilation and other purposes found desirable.

Between the side streets and the central avenue, rows of first class warehouses, five stories high, will be built, varying from 140 to 165 feet in depth and fifty feet wide, which can be connected over the central avenue, and will be seventy in number on the location estimated. As a natural sequence of this construction wing piers will probably be built for commercial uses, but are not included in the present plan.

The object of this general plan is, firstly, to stop the present tidal currents of the East river, without impeding ocean scale of passage; secondly, to furnish a permanent and uninterrupted transit between New York and Brooklyn, for all classes of travel; thirdly, to facilitate coast and ocean commercial storage, transhipment, anchorage, repair, &c., and all its details are adapted to the proper development of these principles.

Location.

The location selected for the initial development of this plan is that part of the East river immediately north of Corlear's Hook, on a center line, connecting Delancey street, New York, with South Sixth street, Brooklyn, E. D., which is near the abrupt turn made to the west by the river.

The reasons which influenced this location may be thus stated, viz.:

1st. The great majority of ocean vessels which arrive at or leave New York do so through New York bay, and except for purposes of construction or repair, large vessels, except sound steamers, are not much seen north of this point. The navy yard and government ships are below it, and herein an objection is obviated which might obtain at Washington against such a pier at any point nearer Fulton

ferry. As one object of this plan is to draw a line of distinction between the ocean and the sound commerce, this location secures the most natural and suitable division, though it does not prevent a convenient passage wherever located.

2d. In construction, the soundings and river-bed on this line, and the channel cross-section, have some advantages. While the channel cross-section is less at any point below the navy yard, and the quantities of material, labor and cost would, therefore, be less. On this line a more convenient arrangement can be made for building the guard-locks and sea-walls, and at the same time keeping open the channel for vessels until completion, since the channel proper is chiefly on the Brooklyn side, and could thus be the last part closed, with less increase of tidal current during construction than on a different channel section; and, in fact, the guard-locks could be entirely built, fitted for use, and connected with the New York side, without any serious alteration of the conditions of navigation which now exist at full flood and ebb tides, assuming the use of steam tugs for sailing vessels, at times of special need. This occurs from the tidal action here, which produces something like an eddy above the Hook on the New York side, and has never cut out the river bed to any depth for nearly or quite half-way across. In connection with this general subject, a little study of the East river charts will show that above the Hook, for a long distance, the New York side is shoal, and naturally impracticable for heavy draft vessels, the deep water being on the opposite side, where no commercial inducements or facilities have been offered to such shipping, which arises partly from the local state of the Brooklyn wharves, but chiefly from the injurious action of the daily tidal currents along that side of the East river.

3d. This location brings the pier directly in line with the main eastern district avenue of Brooklyn, and that area which requires development, not only in this district, but in the older city, and really controls an area of present and prospective use, on both sides of the river, which goes very far toward balancing any present claims of the Fulton ferry line. It also interferes much less with existing ferries. The general plan, however, is independent of this location, and its objects can be attained nearer Blackwell's Island or Fulton Ferry, as circumstances may dictate.

Cost and Detail Construction.

A work of this magnitude, as to character and quantities of materials and work, necessarily involves great cost, and should be estimated

on a liberal scale, with allowances for various contingencies. Its plan should also be so devised as to reduce accidental contingencies to the lowest possible number, while it secures permanent construction.

With this view I have estimated for the use of a solid stone foundation for the entire structure, on each side, formed of a rip rap wall, easily and cheaply made, by dumping refuse Palisade stone, which involves no serious trouble in building, and cannot be displaced when completed, nor can it settle.

This work, except at the tunnel center, will form the foundations of the guard locks, as well as the sea wall; at the tunnel center, for convenience of adjustment and grading, a continuous pile foundation is estimated, cut off at a uniform level, near ordinary river bottom.

On these foundations, of which the piling will precede the rip rap fill, the guard locks will be built, as now estimated, in five timber and plank caissons, carefully bridged and braced, with knees and other frame supports, the center caisson, 258 feet by seventy, being sixty-five feet deep, to carry the tunnel division on both locks for a continuous length of 250 feet, and the central part of both locks. This being properly sunk on its piled bed and anchored, the rip rap base will be made on each side, to a level of thirty feet below low tide, and on this four caissons, each 201 feet by 118, and forty feet deep, will be anchored and sunk, providing for the ends of each lock, joining the center part by cutting through the caissons; a simple device, the main work being performed, will provide for the return walls or each lock face.

This being done, the rip rap work will be built on the New York side, to its proper level, fifteen feet below low tide, and on the north or south side, the crib work will be built and sunk as planned, and the sea wall carried up from low tide to its coping level. The opposite crib work and sea wall can then be made in smooth water, and the central filling of earthwork completed in advance of, and connection with, the tunnel work from the lock tunnel to the shore.

All this being done, under conditions of no extraordinary difficulty, and the guard locks ready for use, the rip rap walls on the Brooklyn side can then be brought up to crib base, on one side of the pier, and to mean high tide on the other side, keeping the face a little slack on its line. This done, the opposite crib work can be anchored and sunk, and its sea wall completed, and afterward the rip rap dam can be dressed over on its slope to crib base, and that side completed in still water. As the object to be accomplished by this temporary rip rap dam is simply to control, without fully shutting off the tidal

current, so as to facilitate building the opposite crib work, there need be no great waste of material in its construction, nor will it require much surface width, and for this use layer stone can be selected; the crib work on the opposite side can be anchored and built with or without this device successfully.

The tunnel work between the rip rap walls will have so heavy a side protection, about 200 feet thick on each side at the base, as to be easily made "thorough cut" showing, without a resort to coffer dams or pumping.

On this basis of plans the quantities and items of cost are thus estimated:

281,000 yards..	Rip rap wall, at $1.25		$351,250
930,000 yards..	Earthfill, 60c	$558,000	
35,000 yards..	Earthfill, 30c	10,500	
			568,000
Guard locks:			
2,125	Foundation piles, $17	$36,125	
	Foundation dredging	675	
2,200 m. feet.	Caisson framing, 60c	132,000	
	Caisson bridging, anchors, &c.	10,000	
25,575 yards..	Rubble masonry, $16	409,200	
3,200 yards..	Cut stone, $45	144,000	
6,800 yards..	Brick work, $18	122,400	
5	Caisson gates, $50,000	250,000	
			1,104,400
Sea wall:			
3,750 feet ...	Crib work, $66	$247,500	
6,375 yards..	Rubble masonry, $15	95,625	
1,390 yards..	Cut stone masonry, $45	62,550	
	Fenders, rings, &c	1,000	
Tunnels:			406,675
38,500 yards..	Brick work, $16	$616,000	
4,500 yards..	Concrete, $8	36,000	
	Sky lights, &c	2,000	
	Stairways	1,000	
2,450 feet ...	Iron railing, $5	11,250	
36,450 sq. yds.	Paving, $2.50	91,125	
51,800 sq. feet.	Flagging, 50c	25,900	
7,760 feet ...	Curbing, $1	7,760	
			791,935
225	Swing bridges		18,000
	Engine, &c		50,000
70	Warehouses, $25,000		1,750,000
	Contingencies		700,640
	Land damages, law, &c		260,000
			$6,000,000

With a margin in this estimate of nearly $1,000,000 for contingencies, &c., after including contractors' profits in the schedule of detail prices adopted, taken in view of the fact that any lower location will reduce the quantity and cost of the work, and that a more accurate examination of this location will probably reduce the quantities and work assumed, it is believed that this sum total is not open to any objections of inadequate amount.

Under the above item of "land damage" is included the expense of opening a street about 140 feet by thirty on the south side of the pier to First street, and widening South Fifth street about twenty-eight feet at one point and forty-two at the other for a length of 186 feet. The pier also occupies pier extension areas on each end, about 390 feet front by 250 feet long on the Brooklyn side and about 290 feet front by 230 feet long on the New York side.

Deducting the cost of warehouses and tunnels, the causeway will cost $3,500,000. The value of the warehouse lots is estimated at $3,000,000, leaving the net cost $500,000.

Income.

The chief direct sources of income from this project will be by tolls from foot passengers and vehicles, from warehouses and wharves; the expenses will be for annual taxes, repairs, attendance, and engines; the incidental sources of income and property valuation are not herein assumed, though of a direct and palpable character in this connection.

In his report of September 1, 1867, on the East river bridge, Jno. A. Roebling, C. E., shows that New York in another half century will rank above Liverpool and London, as a commercial center; that the population of New York in 1870, will be 1,300,000 and of Brooklyn 531,000, or 1,831,000 in all; and in 1880, in New York 1,950,000, and in Brooklyn 1,068,000, or 3,018,000 in all; that on the basis of the aggregate population of 1865, the annual transit of the Union Ferry Company to a portion only of Brooklyn, was 40,000,000 of passengers, not mentioning vehicles; that the estimated transit in 1870, will be 80,000,000 passengers, while the improved facilities of the bridge will make a large percentage of increase peculiar to itself; that a toll on 40,000,000 passengers, from one to three cents each, amounts to $400,000 to $1,200,000 per annum; and that the increase of taxable property in value in Brooklyn, would pay the cost of the bridge in about three years, estimated at five and one-half per cent per annum.

A curious examination of the map of Brooklyn shows that the foot of South Sixth street is much nearer the area of unimproved property in the western district than Fulton ferry, and is at about the same distance, in a direct line, from the corner of Fulton and Clinton avenues, and about 7,200 feet nearer East New York, at the end of Broadway. It follows therefore that the percentage of annual increase in future income favors the location under discussion, from its more ready access to the natural district of development as to distances and as to grades.

If however, we assume the Union ferry travel as a local item, not likely to use this means of transit and that its 40,000,000 and more of present annual passage will be locally confined (an assumption without proper basis of argument since so much of upper and eastern New York seeks that avenue of transit), a simple rule of proportion shows that if these local ferries, communicating with twelve and one-half wards of the city, representing in 1865 a population of 175,000, had this business, the remaining eight and a half wards of 121,000 people controlled a ferriage of 27,500,000 or sixty-seven and one-half per cent strictly an eastern district travel.

At the rate then of but two cents toll, the passenger income of 1870, estimated on the basis of 1865, would be 27,500,000 at

two cents	$550,000
To this the assumed income of $640 per day for 3,200 vehicles, at eighty trips of four boats, for 300 days, is	192,000
The annual value of the warehouses, &c., taken at twenty per cent on their cost, less five per cent taxes, repairs, &c., or fifteen per cent net, is	262,500
Total	$1,004,500

From which the deductions for operation of engines, bridges, gates, &c., repairs, superintendence, &c., may be assumed at

Engines	$20,000	
Bridge, gates &c	18,250	
Sea wall and tunnels	7,300	
Superintendence	20,000	
Repairs, &c	34,450	
Taxes four per cent on $3,000,000	120,000	220,000
Net income		$784,500

Or 13.07 per cent on cost at $6,000,000.

Advantages and Objections.

To compass the range of advantages presented by this plan in a compact form, without expanding the several branches of details in argument, however interesting, and perhaps essential some of them may be, the following outline sketch may be made:

It is claimed then, first of all, that if this plan can be demonstrated to contain a direct and immediate improvement of the Sandy Hook channel, this feature alone will justify its urgent pressure toward construction.

All the scientific surveys and reports on this point make it clear, that the main entrance to our harbor is in a very unsatisfactory condition. Not only does it appear, as per report of the harbor commission of January, 1857, page 33, that it was not then "safe for a vessel drawing twenty-three feet to go to sea, except at half or full tide." But it is also made evident, that there is a gradual northerly movement of the sand formations at the Hook, a gradual restriction of the outlet; a continual deposit of silt on the several bars, and an annual change in the direction of the main ship channel. This arises mainly from the annual deposit of harbor silt not duly carried to sea, caused partly by the silt brought down by the fresh water affluent of the harbor, and partly by the special deposits of dredged material carried down the harbor to a convenient point and there dropped, to be again taken up by tidal action and returned where it came from, or redeposited at Sandy Hook and other points.

The scientific evidence which proves the annual increase of deposit at the Sandy Hook outlet is abundant and conclusive in the coast survey and harbor commission reports, surveys and charts. In 1857 they state that Sandy Hook has advanced toward the channel, "within a century, one mile and a quarter, and for the last twelve years at the rate of one-sixteenth of a mile per annum." In twenty years, "in the main ship channel alone, there has been an actual deposit of 2,532,600 cubic feet (93,800 yards)." The main channel, which once carried forty feet water, is now restricted to twenty-three, and is being gradually forced into Sandy Hook Bay, and in a width of outlet of about seven and one-fourth miles is the only main channel which remains.

It is evident, without much appeal to the authorities of the science of hydrology, that this effect at the ship channel arises from a lack of scouring power in the flood and ebb tides, but chiefly the latter, and

that any increase of such power would tend at once toward an improvement.

If then, we examine the present tidal action in the harbor, we find that it is entirely without a parallel in other localities, and are able to apprehend one radical source of the loss of power in its important ebb flow, and the simple remedy.

New York harbor, by the channel of the East river, has a direct tidal connection with Long Island sound, in a distance of about sixteen and one-half miles. This river differs entirely from the Passaic, Hackensack, and Hudson rivers, which bring a large supply of fresh water into the harbor, not being in any sense an affluent or feeder, but simply a tidal channel.

Now it appears, from a little study of the ordinary daily navigation of this channel, that except for powerful steamers, it is restricted to the times of favorable tidal currents, for vessels passing between the harbor and the sound. About the time of slack low water at Governor's Island, it will be observed from the swing of anchored vessels, that while the Hudson is running down with a strong ebb, between Castle Garden and Castle William, there is an eddy toward the East river, while vessels lying opposite the Brooklyn south ferry house are swinging around, showing a cessation of the East river ebb, at Buttermilk channel some time before that of the Hudson.

Consequently, the rule for vessels going into the sound is to come down the Hudson on its ebb, so as to take the first of the East river flood and carry it into the sound; vessels at Throg's Neck take the East river ebb to Governor's Island. Pilots assert that the first of the flood can be taken at the Battery and carried about thirty miles into the sound; it is also an annual winter experience that ice carried through Hellgate and Throg's Neck, from the harbor, sometimes obstructs the entrance to Throg's Neck, for several days, for westward bound vessels.

The distance from Sandy Hook to Throg's Neck, is about thirty-four and one-half miles, the center of the sound, opposite Bridgeport, being midway between Sandy Hook and Montauk Point, or about seventy-four miles from either.

A reference to the tide tables and charts of the coast survey, shows that the crest of the ocean tidal wave, which enters the Atlantic from its commencement near Australia, strikes Sandy Hook about an hour before Montauk Point. The velocity of the wave of oscillation from Sandy Hook to Governor's Island is 26.34 miles per hour

and from Montauk Point to Bridgeport 27.1 miles. If, then, the velocity of this wave was equal in the harbor, the East river, and the sound, the meeting of the full tides would be about one-half hour's flow east of Bridgeport; but in consequence of the curvatures and contractions of the East river, the travel of the harbor wave in the sound is delayed, and while the first of its flood passes a long distance eastward of Throg's Neck, the superior velocity of the sound tide, enables it to arrest this flow, so that with a crest level of 1.6 feet above that of Bridgeport, at Oyster Bay, twenty miles east of Throg's Neck, four-tenth above that of Land's Point and Throg's Neck, the tidess mutually balance their forces in that vicinity. Then occurs the ebb flow in opposite directions from the vicinity of Throg's Neck, as shown by the coast survey charts and the experience of navigation. It results from this action that a considerable portion of the harbor flood, probably fifteen per cent, thrown into the sound through these advantages in distance of travel and time, is lost to the ebb flow of the harbor, since the sound ebb prevents its return at Throg's Neck.

When the tides turn at Throg's Neck, another important but entirely natural process occurs. The sound ebb proceeds toward Montauk Point with a free flow; but the harbor ebb, having a restricted Hellgate channel to pass, returns with less velocity than the flood run, its feeding supply being also diminished. So we see by the current charts of part of this passage that a flood run of 3.07 knots per hour near Polhemus' Dock has an ebb of 2.65; opposite Hallet's Point a flood of 7.83 to 11.1 knots for an ebb of 4.4; on the east side of Blackwell's Island a flood of 4.3 knots has an ebb of 3.53 to 3.96. The action at Buttermilk Channel of a depleted East river ebb, is thus explained: At Sandy Hook, where the ocean wave regulates the outlet in part, the ebb has about nine minutes less duration than the flood.

These simple but decisive facts prove that the East river is nothing less than a continual outlet toward Montauk Point, of an important part of the legitimate flood tide and fresh water supply of New York harbor, pouring in that unnatural and hurtful direction, the volumes which, properly retained and assisted, would sweep out to sea at Sandy Hook with a largely increased ebb, and with an absolute and permanent effect.

This improvement in correcting this great defect corrects others:

The importance of the Hudson river as a tidal reservoir to the Sandy Hook channel is repeatedly urged in the reports of the harbor

commission, and its commercial importance does not require argument. From an examination of the flood wave of oscillation it appears that its velocity is, from Sandy Hook to Governor's Island 26.34 miles, thence to West Point 22.16, thence to Poughkeepsie 15.63, thence to Tivoli 20.26, thence to Stuyvesant 13.51, thence to Castleton 8.21, and thence to Albany 9.81 miles per hour; the mean rise being at Sandy Hook 4.8 feet, Governor's Island 4.6, Poughkeepsie 3.4, Stuyvesant 3.67, Castleton 2.66, and Albany 2.5 feet above low tide level. At Albany the time of high water is ten hours and twenty minutes later than at Sandy Hook, the mean duration of the flood being four hours and twenty-six minutes, and of the ebb seven hours and fifty-nine minutes; at Tivoli the flood duration is five hours thirty-six minutes, and ebb six hours forty-nine minutes; at Poughkeepsie, flood five hours forty-one minutes, ebb, six hours forty-four minutes, at Governor's Island, flood five hours fifty-four minutes, ebb six hours thirty-one minutes.

In a recent report on the improvement of the Hudson, I had occasion to show that the expenditures made on the channel below Troy, had amounted to more than $1,000,000, chiefly since 1845, and new expenditures are now annually made by the State and government. This outlay has been required on account of the lack of ebb or down stream flow, at certain points of sufficient power to prevent silt deposits. It is evident from an inspection of the tidal notes given, that above Poughkeepsie, the current of the river is exposed to continuous counter actions from the obstructed movement of the flood wave and its want of volume and force in the upper stream.

Now if this tidal action can be changed so that the river will take a stronger and swifter flood, its level at Castleton will not only be raised, with a great improvement to commerce, but its ebb velocity and volume will be increased, and the benefit will be felt all through the river and at Sandy Hook also. Its great fresh water volume which flows past Fort Edward 800 feet wide, and six to eight feet deep, or past Albany 950 feet wide and ten feet deep, and is scarcely brackish at Poughkeepsie, will no longer be in part arrested and wasted at the Battery and in the sound, but in all its power it will be able to go out to sea, carrying the silt in suspension, which it now deposits along the upper river, and directly near and at New York, where it meets the flood tide. So much of this city deposit as occurs on account of this meeting, will then be transferred to a point higher up the river where it can do no harm, and in the improved ebb flow

the tendency will be to prolong the suspension of silt, and not only increase the scour at Sandy Hook but reduce materially the daily deposit there and in the harbor. This covers not only the very important item of improved river commerce, which commerce is of vastly greater consequence than the coasting trade of the sound, since it pertains to New York, and the great west and Canada, but it directly alleviates the great annual expense of slip and basin dredging along the commercial front of the rivers, where now an annual deposit of silt of twelve to eighteen inches in depth occurs, attributable to some extent to city sewage, steamer ashes, and other local causes, but not so prominently, for sewage flow, surcharged with Croton water and running freely through miles of culverts, does not change its nature when it strikes the tide, as can be shown by abundant testimony, if such details were not excluded from our present argument.

With these ship channel and river benefits come the direct benefits to the East river itself. It is now an almost unnavigable and non-commercial gorge, swept as it is, four times a day, with swift currents; dangerous even to vessels at the wharves, they can hardly enter and leave with the experienced help of our large fleet of steam tugs created by these dangers; unsafe for sailing vessels, for anchorage, and for ferries; obstructed in winter seasons often, with vast fields of ice, practically severing the two great cities and giving rise to continual complaints; restricted also by rigid laws in its bulkhead and pier extensions, so that a great commercial city, which hopes within fifty years to rival Liverpool, cannot now berth her waiting ships, and drives her commerce to an opposite shore.

Under the present plan for the improvement o Hellgate the government is expected to spend $7,000,000 to secure twenty-six feet waterway. A clear waterway for the main channels is of course valuable, but this expenditure will not practically improve the navigation of Hellgate, as the best authorities have admitted, simply because it will not reduce the excessive velocities of the tidal currents of eight and a half to eleven knots an hour, which now make the crooked channels a terror to vessels of all classes, and an impossibility to sailing vessels of ocean draft and bulk. These and other civic and commercial obstacles, will be at once relieved by relieving their actuating cause and giving the East river, from the Battery to Throg's Neck, no other currents than those of ordinary tidal rise and fall.

Although this project involves no immediate change in the Harlem

river, beyond the construction of a guard lock and some channel improvement, it will undoubtedly lead to its improvement as a ship canal, and on a more direct line than it now has. The use of this river will not only save the sound commerce, which now does business chiefly on the Hudson, the difficult, expensive and circuitous passage around the Battery, with a distance gain of about eighteen miles, but upper New York will then have an opportunity of adequate commercial development. New York merchants annually crowded further away from their business localities in search of homes, must have before long, an enlarged range of wharfage and warehouse facilities, or they will be driven to the opposite shores.

Of the advantages which immediately follow an adequate and permanent connection of both cities by avenues of slight grade and ample width and on a location which, without injuring the great ferry system of the older Brooklyn, really controls the future center of population, it cannot be necessary to make much argument. Upon the principle of the important decision of the final Court of Appeal in the Rock Island bridge case, where the Mississippi was ordered to be bridged, because this involved the greatest good of the greatest number, very serious inconveniences to East river navigation would be not only justified but legally sanctioned, if such injuries were even formidable in character. What this plan proposes to do for the main arteries of New York commerce at Sandy Hook and at Albany, it also comprises as a municipal benefit, in the complete junction of cities which now aggregate more than a million and will soon double that number. If a few enterprising citizens of Brooklyn are willing, with their common council, to incur an expense of about $12,000,000 for an elevated bridge, certainly this project, at even twofold the cost, is amply justified through its superior civic advantages. Continuous and safe foot passage, street railway, and vehicle transit; pneumatic tube expressage and telegraphs; great wharfage and storage facility; large increase of population and taxable property near the great center of business, are among the evident and immediate results of this plan.

OBJECTIONS.

An important project like this, affecting many different interests, must needs meet strong opposition, some of it factious and unreasonable, and some worthy of careful deliberation. These objections, however, are to be examined and settled by the principles which

determine all public improvements, and justify the arbitrary exercise of "eminent domain," which builds our railways, canals, waterworks, sewerage and all like constructions. The Aldersons, who limit the speed of the locomotive, before an English parliament, to five miles per hour, and see it at a stand still in the face of a strong wind, and the Dr. Dardners, who see an ocean steamer in a passage of ten days across the ocean, plowing through a medium like molten lead, must also have their predictions consulted and their decisions discussed. For the present, to examine two or three salient objections will suffice.

The first and most important is that of obstruction to the navigation of the East river, as a national highway.

To this we answer, 1st, that the custom house revenue and commercial profit of any improvements at Sandy Hook, at Hellgate and in New York harbor, far outweighs all the income from annual enrollment fees of the town commerce, and the amount of its local business; and that the same argument is true of any improvement to the commerce with the great west and Canada in the river at Albany.

2d. That the government naval station here now suffers seriously on account of the East river and Wallabout channel currents and counter-currents, so that the anchorage is not safe opposite the cob dock; launching and dry docking are seriously embarrassed, and in the winter the ice fields expose naval vessels to great damage, while the annual silt deposit at the navy yard involves great expense for dredging; and as, from motives of prudence, naval vessels very seldom go through Hellgate, this plan involves great benefit and no injury to the naval station.

3d. We assert, as a matter of daily demonstration, that the East river is not a navigable highway at all, to sailing vessels, except at limited times of the day; that the prevalence of contrary winds seriously affects the value of these intervals of time; and that practically, with the increasing restrictions of this river, due to the increase of piers, &c., building to the harbor pier line, this evil is rapidly increasing. This commercial restriction will be entirely changed by this plan, with its guard locks; and instead of a dangerous voyage of seventeen miles, only possible at four intervals of time each day, the restricted distance is reduced to 450 feet, with an easy run to it from both sides, with four periods of the day when the caissons can be thrown open and a free sailing passage offered, and with a compact and simple arrangement of steam power at hand, at all other times

to make the passage safe and easy. So far then from being a hindrance to East river navigation, this arrangement will perfect it, seriously reducing all its dangers and expenses, and losses of time. The objection that the sound steamers will be detained is not of much consequence, since the limit to their use of North river piers can be very certainly predicted. Beside this, it is so evidently for the benefit of the harbor and the sound, that the coasting trade should not be carried around the Battery, and there is so important a range for it along the East river, north of this pier and the upper part of New York city, that whether this plan is carried out or not, the time is not far distant when port regulations will themselves restrict this business to these limits.

To explain more clearly the precise effect of these guard locks on the Hellgate commerce, the following statement may be made:

It appears from statistics reported by Thomas F. Rowland, Esq., to the East River Improvement Association, that during the four months ending November 30, 1868, the total pasages of steamers were 2,434, of ships only eight, of barks twenty-two, and of brigs, schooners, and sloops, 16,994 in all. Rejecting the steamer account, the average number of passages each day is 140, on an average of thirty-five both ways at each tide. Now if these thirty-five vessels approached the guard locks under the same laws as to time of transit they now accept, and, as it will be their interest to do, or four times each day of twenty-four or twenty-five hours, they could sail through on slack water without lockage; but if locked, the whole lockage time, working them in fleets, need not exceed eighty minutes per day. Suppose, however, there were an occasional detention of two or three hours, of what moment could it be in comparison with the present losses of time at the Battery and Throg's Neck; the occasional detention for days and weeks from ice and fogs in the winter; the relief of danger, marine insurance, and steam towage at Hellgate and other points; the reduced liabilities of collision with ferry boats and other vessels; and the greater ease, safety and economy of new wharf berths. So far from being in any practical sense an obstruction to East river navigation, this plan redeems it from its chief objection, and creates a navigation now impossible.

The second objection which will be made is of a scientific character. It will be said that the Flushing bay, west of Throg's Neck, now forms an important tidal reservoir, for the benefit of the ebb flow, and this action will be lost by this pier.

In reply we say that it is precisely the value of the principle of tidal reserve which we propose to maintain, except that we substitute the extensive surface area of the lower Hudson for the limited surface of Flushing Bay, and do this without the serious losses of tidal supply which now occur immediately east of this bay. A slight increase of river depth will readily balance all the contents of the bay, and the effect on the ebb return will be much more direct and powerful.

A third objection will be made on sanitary grounds. It will be urged that the East river tidal currents now carry off the sewage flow of the cities, and to impede these currents will affect public health and make solid deposits along the river.

The answer is, that a very erroneous popular idea exists as to the character of sewage flow, that our sewers, so far from being sluggish vehicles of heavily surcharged matter have, in reality, so excessive a proportion of water, being the immediate outlets of the city water and rain supply, that the solid and organic matter is readily held in suspension, and, in fact, is so entirely thus held, that all general attempts to utilize sewage flow for manuring purposes have nearly always failed on account of this surcharge of water, and that there are wells in public use, in some localities actually less free from solid matter than our sewage.

While it is true then, that the trunk mains which discharge into the river, may at times carry an unusual proportion of sand, street dirt, and other solid matter, and form a deposit at their mouths; this material is not objectionable in a sanitary sense and its amount is comparatively insignificant when compared with the present annual deposits of river silt, which now cost about $300,000 a year to remove, and which this plan will effectually modify.

Practically, as a question of health, or as a question of dredging, this objection has no special force. The water of the harbor and East river will be twice daily changed and renewed, as now, from the great ocean reservoir; and if it was not, the whole sewage flow of both cities could do no more harm, at the greatest, than it now does in the precincts where it is created and put in motion, and is constantly exhaling.

Taking the daily water supply of both cities at 75,000,000 gallons, the amount of sewage matter will not exceed or equal 11,000 tons, or about 7,000 cubic yards, while the amount of fresh tidal water thrown into the harbor and the rivers above the Narrows, twice a

day is about 900,000,000 tons, a fact which effectually dispels all question as to the sanitary effect of such a causeway.

Names.	Supply.
Harbor and Newark bay	190,000,000
Hudson river	460,000,000
East river and sound	180,000,000
	830,000,000
Sound loss	140,000,000
	690,000,000

At the conclusion of Mr. McElroy's paper, Mr. Emery made some remarks as to the great value of the paper just read and the statistics embraced in it.

The discussion as to improving New York harbor, and the influence of bridges across the East river, was continued until a late hour, when the association adjourned.

February 25th, 1869.

Professor S. D. TILLMAN in the chair; Mr. C. E. EMERY, Secretary.

THE TUNNEL AT CHICAGO.

Mr. Thomas D. Stetson gave a detailed description of the Chicago tunnel. The Thames tunnel, he said, was not quite a success, on account of the poor way for carriages to get into it. There is a place for foot passengers, but none for carriages. The Chicago tunnel is the only large one under a river where carriages can cross with ease. The water is fourteen feet deep from the lowest water line, and the width of the river is 200 feet. The top of the tunnel is on a level with the river. After the brick work was finished, it was proposed to cover it with lead, but it was covered with mastic and cement, the refuse of petroleum, and other things, some five-eighths of an inch thick. Over that was placed masses of concrete; then this was covered with flag stones. This Chicago tunnel is the only one in America which is a success. It is designed to have it well ventilated. There is a strong current of air through it. The grade is one in sixteen feet, about the same as that at the Brooklyn side of the Wall street ferry. The width of the arches is thirteen feet; the foot way is about nine feet, and the carriage way ten feet. It is lighted by

gas. There are a series of eleven arches, just large enough to go through, and a couple of gas burners are under each.

New Grate Bar.

Mr. J. N. B. Carver exhibited Mr. N. B. Schofield's corrugated grate bar. The bars are corrugated longitudinally, with a corrugated narrow bottom, which prevents its warping.

Dr. P. H. Vanderweyde thought the plain bar would answer as well as this. He did not see how the corrugation improved the bar.

Dr. D. D. Parmelee said that the quality of the cast-iron has much to do with the trouble of grate bars. While crystallized iron is the best material for making these bars, and not the cast-iron that melts at a low temperature. There is more in the quality of the iron than in the form of the grate bar.

New Cash Drawer.

Mr. R. B. Zwallen exhibited a cash box, with secret drawers, of an improved construction. The invention was closely examined, and its simple mode of security was warmly approved.

Model of a Tunnel under the East River.

Mr. Edwin Ferguson presented a model of his method of laying a wrought iron tunnel in sections for the East river, to be laid on the bed of the river. Each section consists of two cylinders, with eliptical cross section, one within the other, firmly connected together. The cost to build this tunnel would be two and a half millions dollars. The tubes or cylinders are to be made of boiler iron, and can be put down in any required length, and laying on the bed of the river, will not damage anything whatever.

Mr. B. J. La Motte exhibited a model and read the following paper on

Proposed Iron Bridge over the East River.

In every enterprise, two things must be well considered: The amount of good it will do on one side, and the amount of evil it will do, or may do, on the other side. If the amount of good and evil will nearly balance each other, then it is just as well in such a case to let the enterprise alone.

It appears to me that the contemplated bridge over the East river has some points highly objectionable connected with it; but the principal one of these will be its great height from the water level, being

about, as I understand, 125 feet; that elevation being necessary to allow ships with masts to pass under it.

For my part I think it is quite safe to predict that twenty years hence there will be no more sailing of ships with masts, particularly in civilized countries; but that steam or some other equally efficient power will altogether have superceded the uncertain, slow, and capricious mode of locomotion on water by wind. Hence that great elevation in that bridge will then be wholly unnecessary.

But even were it probable that there will be sailing of ships with high masts for ages to come, it is rational to say that the amount of evil and inconvenience resulting from such a high structure will far more than balance all the good it might do at all events, and the reason is very obvious:

Let us suppose, for example, that only 50,000 were to cross daily over such a bridge; then every one of these would be obliged to ascend and descend 125 feet to and from the water line. And what for? we will ask. Simply to allow a few lazy ships with high masts to crawl to and fro under the aerial structure. I think in this case we should all agree with the memorable Dr. Benjamin Franklin, and come to the conclusion that it would be paying too dear for the whistle.

But without more preliminaries, as time is precious, there is in this case a way of securing all the main advantages without meeting counterbalancing evils; that way it seems to me, and I am not the only one of the same opinion, is simply this:

Make a bridge of such a height as to allow only steamboats and all manner of small crafts to pass to and fro with perfect freedom under it at all times.

For the comparatively few vessels with high masts, plenty room may be found in the North river, and other parts of New York bay.

Such a bridge as I would propose would not cost one quarter as much as a suspension bridge, with its numerous appendages, is estimated at.

Besides, it would be an ornament to both cities; and it would be a pleasure instead of a task to travel over such a bridge. Others may elaborate, with more ability than I do, this part of the subject.

The kind of bridges proposed by me need be only forty feet above the water on the New York side, and as high as Brooklyn Heights on the eastern termination.

As to the bridge itself, and the mode of its construction, I will submit my views briefly; although I regret I have not a more com-

plete specimen for an illustration of it; still I hope a tolerably clear idea may be formed of the whole plan.

In a structure, particularly in such as a bridge, there must be no guess work; there must be harmony and consistency of all the parts throughout; in a word, there must be a certainty as regards perfect security under all circumstances.

It is well known to all engineers, and to all persons of judgment, that the security of a bridge depends either on rigidity or tensile strength, or the two combined.

It is also well known in mechanics, that the more simple the mode of construction the better and the more reliable will be the structure.

In the plan I propose, all that is required to build a bridge is simply to bend tubes or rods to the proper shape and size of the bridge, and slide these tie blocks to their respective places; and then pass the longitudinal or connecting rods of soft steel (either in the shape of rods or steel wire cables) through these holes in the tie blocks, and cross ribs, in one piece (or its equivalent); and then secure well these longitudinal soft steel rods or cables, throughout the whole length of the bridge to the abutments; thus doing away altogether with bolts, nuts, tie rods and braces, and with any cutting of the parts whatever.

And having symmetrically well combined and harmonized the whole structure, the bridge will possess all the strength inherent in the metal itself; combining in the same structure both the truss and the suspension systems. Because, let it be well understood, the component parts have not in the least been affected by boring or cutting away; but on the contrary, each remains altogether whole and a perfect unit, allowing expansion or contraction at divers temperatures, with perfect freedom throughout; and without any undue strain to one part of the structure, at the expense of another.

As the main strength and security of all bridges depend principally on the combined tension of the longitudinal connections; and as every one of these soft steel connecting rods, or cables, is held firm at the abutments independently of the others, according to my plans; it follows, from the whole arrangement, that each rod or cable can be tested at all times, and the strength of the structure as a whole, can thus be always determined with positive certainty.

Phenomena of Color.

Dr. P. H. Vanderweyde said it was Sir Isaac Newton who first started the investigation of color in a scientific manner. He discovered

that a prism of glass would refract and disperse a ray of sunlight, giving rise to an image formed of a series of colors called the spectrum. He discovered that the light of the sun consisted of seven different parts; but how the prism separated these he did not explain. There is another way of separating light, and that is by Fraunhofer's lines as seen in the spectrum by the aid of a telescope. These lines are so close togther as to make 7,000 to the inch. (The doctor here exhibited Fraunhofer's lines). Where a thermometer is placed in the rays of the spectrum, the yellow light shows a slight increase of temperature, and the orange more, and the red the highest heat. In the other rays there is hardly any perceptible heat. Photographers know that the blue and violet have the greatest photographic effect. The greatest strength, photographically, is in the violet; the greatest heating power is in the red ray. Light is transmitted with enormous velocity. It takes eight minutes for the light of the sun to reach the earth, so the velocity of light from the sun is 200,000 miles in a second. The undulatory theory of light, first proposed by Huyghens, is now universally adopted. Our study of sound has given us a key to the theory of light.

Light consists of waves, just as sound is transmitted, which moves with a less velocity than light. The length of a wave of light is about an eight hundred-millionth part of a millimetre. When we divide the length of the wave with the light we get the number of waves in a second. Suppose two waves of sound follow each other in one second, we have 750,000,000,000 of vibrations in a single second. The velocity of undulations producing red light is 472,000,000,000 of vibrations in a second. The vibrating medium cannot vibrate at a lower or higher velocity than this; so it always gives this red color. Color is only an impression that is given to us. There are persons who are color blind; in the same way we have persons who cannot distinguish the vibrations of sound, and know scarcely one sound from another. That we see a color is only an objective fact.

The diagram here shown is the spectroscope line for calcium, which shows that the sun contains calcium. Here again we have the lines for gold, silver, etc., which proves to us that the sun contains these and many other metals. The Geissler tubes have been shown here before. Those tubes exhibited that evening were filled with gasses of different kinds, which give various colors when electricity is passed through them. Hydrogen is very white. The spectrum of oxygen

is more complex; but nitrogen is the most complex of all, in which some fourteen lines are seen.

Common air shows a mixed composition. The weakest of liquid homœopathic medicines, the components of which could not be detected by chemical analysis, are visible under the spectroscope. On burning a few grains of gunpowder, by the aid of this important instrument, its composition can be determined.

The following is one of the papers read at Chicago, which were alluded to at the first September meeting of this association.

On the Combining Power of Chemical Elements.

Read before the American Association for the advancement of science, by Professor S. D. Tillman, of the American Institute, New York.

Since the promulgation of the doctrine of types and substitutions, the saturating powers of chemical bodies have been quite satisfactorily represented by symbols. The prominence which the subject of atomicity has recently assumed is partly the result of the plain and simple manner of illustrating it. By means of the new notation, and several additional characters or signs, an ideal structure of a chemical body is represented; for of the real structure nothing is known. In it the saturating power of an atom, or a combination of atoms, is measured by degrees, the lowest power being taken as the unit of measurement. A given number of combining units require a like number of other combining units to complete the structure. The new body is always the result of duality, and its form or type will be retained while its chemical functions may be entirely changed by displacement; for certain parts of the structure may be removed provided a substitution of the same equivalence is made to preserve the molecular equilibrium. Thus the chemist assigns substitution values to every simple and complex radical, and designating them by numbers, from one up to six, is prepared to combine his symbols in a process of matching, which, although quite as simple as that with dominoes, affords the highest satisfaction, because it is always associated with the order, rapidity and precision of molecular changes. Yet this kind of chemical reckoning has one serious drawback, namely, the atomicity of the same element is not an invariable value. It is often decreased by a duplication of similar atoms, and, in some remarkable instances among monads, it seems to be increased beyond its normal energy by a kind of induction which has not yet been accounted for. Saturating power depends on causes

and conditions still wrapt in obscurity. Equivalence involves higher questions than those of quantity and quality, as these terms are applied to ponderable matter, for two elements having diverse chemical functions and widely differing atomic weights, like hydrogen and chlorine, sometimes assume the same relative position in the mazes of chemical combination. In many instances, attractive force or affinity seems subservient to fitness of place; hence has arisen the distinction of chemical and mechanical or molecular types, which can only imply that one kind of force is more effective than another in completing what may be termed the symmetry of the chemical structure. The smallest quantity of an element which can enter into combination has an invariable weight, and doubtless a normal sphere of attraction, which may be modified in its relations to that of another element, on changing the rate and range of the undulations of the interatomic medium through the agency of light or heat; or on disturbing its general equilibrium by what is termed electric force. It is evident that the minute changes which a molecule undergoes in chemical action involves a problem of motions too complex for complete solution.

Considerable diversity of opinion still exists among advanced chemists, both as to the best form of types and the highest saturating power of several elements. Indeed, the value of the same element varies so much under different conditions, that some writers, regarded as authorities, are now inclined to include all simple bodies in two classes, one embracing combining units expressed by even numbers, and the other those expressed by odd numbers. Some of the late conclusions of the ablest advocates of the new views would seem to obliterate even this single dividing line of distinction. Professor Wurtz of the College of France, in his admirable lectures on "Types and Atomicity," is reported by the London *Chemical News* as saying: "Nitrogen seems to us diatomic in the binoxyd of nitrogen." This body, according to the new notation, is a combination of one atom of nitrogen (14) with one of oxygen (16). The statement taken literally would place nitrogen in both classes alluded to. With equal consistency it may be asserted that nitrogen in the peroxyd of nitrogen is tetratomic; and by a parity of reasoning nitrogen becomes a Proteus among types! Now, while it is admitted that only two-thirds of the normal saturating power of an atom of nitrogen is expended in combining with one of oxygen, it may with great plausibility be assumed that the remaining unexpended combining unit actually determines the value of this body as a monad radical. It

cannot exist in a separate state, but two such compound atoms or atomoids, will unite like two atoms of nitrogen, to form a molecule. In this manner the peroxyd of nitrogen is shown to be also monatomic, because two atoms of the dyad oxygen have a substitution value of four, and exceed by one that of nitrogen. In one case the value of the radical is expressed by 3—2, and in the other by 4—3. Nitrous anhydride and nitric anhydride are formed on the water-type by the addition of an atom of oxygen to two of these radicals respectively. The lowest oxyd of nitrogen, laughing gas, is an inert body having neither alkaline nor acid characteristics. Its atomoid contains two atoms of nitrogen and one of oxygen, and its combining power is expressed by $2\times3—2$. Should it hereafter be found to act as a radical, it is here predicted that its value will be tetratomic.

An example bearing still more directly on the question of the atomicity of nitrogen is that of cyanogen, an atomoid of which contains an atom of carbon (12) and an atom of nitrogen (14). If these two atoms meet on equal terms, either the carbon atom becomes a triad, or the nitrogen atom a tetrad. On the other hand, if it is assumed that both elements retain their normal saturating power, carbon as a tetrad and nitrogen as a triad, we satisfactorily account for its monatomic substitution value which is expressed by 4—3. In its general behavior this radical resembles the halogens; thus presenting an apparent anamoly in the formation of a compound having powerful electro-negative characteristics found in neither of its constituents, and proving that the predominance of atomicity in an element does not necessarily impart to the body of which it forms a part any of its chemical functions; in other words, that the atom of lowest combining value is not merged in that of the highest, but that, as between the two, the merging is mutual; the result being an absolutely new body bearing no resemblance to its constituents in a separate state, and exhibiting only that relation to them which arises from the law of differential atomicity. This law was expressed in a paper read by me before this Association in 1866, as follows: "The atomicity of a torso (that is an imperfect body having no separate existence) or of a radical containing one atom of an element united to one or more atoms of another element is equal to the difference between the normal saturating power of its components."*

It is difficult to trace all the steps of the resulting atomicity in

* Dr. Aug. Kekule of Erlangen, Bavaria, was the first to explain why certain complex chemical compounds of the same ultimate composition often differ in atomicity.

bodies containing only two elements when the atoms of both elements are duplicated, because such duplication involves an unequal decrease in their normal atomicity. However, in a homologous hydrocarbon series, in which the number of atoms of each element forming a molecule increase by arithmetical progression, the lowest supposable combination will be the measure of the atomicity of the sum of the carbon atoms in every member of the series; for example, the body not yet isolated, consisting of one atom of carbon and two atoms of hydrogen, would have a combining power expressed by 4 — 2; accordingly we find that ethylene, and every other homologue has the value of a dyad, and may be united with two atoms more of hydrogen. Thus in the hydride of methyl series, the saturating power of a given number of condensed carbon atoms is expressed by the number of hydrogen atoms in the combination, which is the measure of the power of the same number of carbon atoms in other bodies; for example, the composition of hydride of ethyl proves that two atoms of carbon play the part of a hexad, therefore the saturating power of acetylene, composed of two atoms of carbon and two of hydrogen is expressed by 6 — 2. This branch of the subject cannot be presented even in outline without the use of symbols; and as the symbols I use are not yet generally adopted, and might divert attention from the principal points to be elucidated, I do not propose to introduce them in the present paper.

Our subject in its broadest meaning includes investigations relating to the diversity of composition in chemical bodies. The cause of this diversity may be assigned in a general way to affinity, by affirming that a powerful electro-positive element combines most directly and intimately with a powerful electro-negative, producing at once a compound in the most condensed state; as for example, sodium and chlorine in forming common salt, while elements having less affinity may unite by degrees in a variety of forms, as seen in the combinations of oxygen with nitrogen, sulphur and the halogens. This tendency to diversity is more remarkable among metalloids than among metals, for the latter, with one exception, are solids, and in general, are not readily brought into the liquid and gaseous states.

Nothing in the whole range of nature's operations excites greater wonder than the fact that a large majority of the chemical bodies derived from the organic kingdom are composed of the same three or four elements, which by diversity of combination give as great a variety of characteristics. In ammonia, nitric acid, laughing gas,

olefiant gas, ether, alcohol, aniline, water, spermaceti and the gaseous mixture forming the atmosphere, a combination of two or more of these elements exhibit the most striking contrasts. On examining hydrogen, oxygen, nitrogen and carbon, separately, among other peculiarities will be found the following:

1. Three of them are permanent gases, which have resisted all attempts to liquify them by means of cold and pressure; and the fourth is a permanent solid, which in its purest form, the diamond, has maintained the same state, *in vacuo*, under the highest degree of heat yet applied.

2. These elements are colorless under all attempts to change their natural state, yet by combination they evince every tint and shade of color.

3. Taking the weight of the hydrogen atom at one, the combining numbers of oxygen, carbon and nitrogen are low multiples of the prime numbers two, three and seven, respectively; from which the inference is drawn that harmonic relations exist between the vibrations or undulations produced by or in these elements. These coincidences may seem to have little significance, but when taken in connection with the remarkable relations of atomic weights of three elements in several different groups discovered by Dumas, and the general difference in the atomic weights of nearly all the elements, as pointed out by M. Carey Lea, they indicate the connecting links between form and motion, an allusion to which will be found in a previous paper on harmonic relations, and seem to confirm the surmise that all chemical elements are the offspring of the universal æther, first quickened by the divine Author of all, and ever moving in accordance with His stupendous plan.

To return to nitrogen; its connection with the highest prime number which belongs to harmony, would indicate that it does not frequently and readily enter into chemical combination. A natural inquiry arises here, whether any element supplies the missing prime number? The atomic weight of calcium is a multiple of the prime five. This brilliant yellow metal enters into the composition of all bone, and, in combination with oxygen and phosphorus, forms the foundation of the animal structure. Ample reasons may be adduced for not finding in the atomic weight of phosphorus more simple numerical relations; however some significance must be given to the fact that phosphorus forms just one-fifth of the weight of animal phosphate. Two other elements entering into the animal organiza-

tion are connected by similar numerical relations with those already mentioned, sulphur with oxygen, and iron with nitrogen. Other interesting coincidences might be pointed out did they not give too much prominence to views which at present will be regarded as merely speculative.

4. The normal saturating power of hydrogen, oxygen, nitrogen and carbon, are respectively as 1, 2, 3 and 4. Binary combinations of these elements will indicate the direction in which we are to look for the principal cause of diversity in the composition of organic bodies. Of hydrogen and oxygen only two combinations are known: of nitrogen and oxygen, five; of hydrogen and nitrogen, one; of carbon and nitrogen, one; while of carbon and hydrogen over thirty have been thus far isolated. The remarkable tendency of the lightest gas and the most impenetrable solid to combine in definite proportions, and to condense by degrees, thus forming homologous gases of different densities, as well as liquids and solids of different boiling points, must be assigned as the principal cause of the diversity of composition found in the many hundred compounds of which these two elements form a part.

Berthelot has recently demonstrated, by numerous experiments, that alcohols, ethers, aldehydes, alkalies, acids and other compounds containing carbon, may be decomposed by the action of hydriodic acid and heat, and converted generally into homologues of the hydride of methyl series; and he has expressed the opinion that the carbon in all organic bodies may be thus saturated with hydrogen. The startling conclusion to be drawn from his experiments, the facts set forth in this paper, and all previous experiments showing the disposition of hydro-carbons to combine with other elements is, that the great antipodes in extension, carbon and hydrogen, play the principal parts in the composition and decomposition of all bodies derived from the organic kingdom.

Adjourned.

March 4th, 1869.

Professor S. D. TILLMAN in the chair. Mr. C. E. EMERY, Secretary.

The chairman read the following notes on new scientific experiments and discoveries:

Remedy for Wakefulness.

Prof. W. A. Hammond, of Bellevue College Hospital, New York, gives, in *The Medical Record*, an interesting paper on "The Therapeutics of Wakefulness," which contains the following passage: "But of all the sleep-producing agents at our disposal, the bromide of potassium is most deserving of the name of hyphotic. I have never seen it fail when given in sufficient quantity. A healthy adult may take from twenty to thirty grains three times a day; the latter is not too large when it is needed at all. Sometimes it produces, among its other effects, great weakness in the legs, and a staggering gait, strongly resembling that of a person intoxicated with alcohol. In fact, I know a gentleman who, while under the influence of this drug, was twice arrested in our streets for drunkenness. Bromide of potassium occasionally produces great lowness of spirit and a disposition to cry. It should be administered very much diluted. It may be conveniently prescribed, one ounce to four ounces of water; a drachm dose of this to be given in at least half a tumblerful of water.

A remedy which I have used recently, especially in cases of nervous excitement, where a sedative seemed indicated, is sumbul. This is a plant of the same family as valerian. I have used it in conjunction with bromide of potassium, in epilepsy, with the result, I think, of increasing the effect of the latter. The dose of the fluid extract (Neergaard's) is from twenty drops to a drachm three times a day.

Cannon Shot and Armor.

Recent experiments by the ordnance department, made at Shoeburyness, England, have shown that the force of a cannon shot in foot pounds is the weight of the projectile multiplied by the square of the velocity divided by twice gravity, equal to sixty-four. For example, a Rodman projectile of twelve inches diameter, and weighing 620 pounds, striking at one-third of a mile distance, equals in round numbers 15,000,000 foot pounds. This effect is the same within certain limits with heavy shot with low velocity, and with high shot with high velocity, producing the same force of impact; but with shot of different diameters the force must be proportionate to the diameter, as in ordinary punching. The resistance of armor plates varies nearly as the square of their thickness. This applies only to solid plates, and not to a series of plates bolted together. A four-inch solid plate could not be penetrated, while a six-inch laminated plate was easily penetrated by cannon shot of the same force.

Experiments have shown Sir William Armstrong correct in his statement that in hard well tempered steel shot *the work* expended on the shot was one-tenth of the whole work; with soft steel the work expended on the shot was two-tenths, and with soft iron five-tenths. This he explains by the dynamic effect of heat at the instant of concussion. The experiments on the English armor targets show that loose wood backing is useless, and a rigid backing of wood is an advantage, and is very great if it has an iron skin behind, connected by ribs with the front plate.

Concrete Bridges.

The new concrete structures recently erected on the Metropolitan Extension railway, between Paddington and Brompton, London, has been tested to ascertain its tensile strength. The structure is an arch entirely of concrete, of seventy-five feet span, and only seven feet six inches rise. It is three feet six inches deep at the crown, and has a uniform width of twelve feet. The materials and proportions employed were six of gravel to one of Portland cement, and dependence for cohesion was placed rather upon thoroughly mixing the materials than ramming. In making the test, 170 tons in weight were equally distributed over the surface, and a train of several freight cars, weighing fifty tons, passed over it. Under this weight there was practically no deflection. It seems probable that this favorable result will lead to the more extensive use of this artificial mixture as a building material.

Glass-wool.

At the last exhibition by the Polytechnic Association of Vienna, a new product of art was shown, consisting of glass spinnings, and embracing ornaments for the hair, ribbons, bracelets, cuffs, collars, watch-chains, imitations of curled and smooth ostrich feathers, etc. They were manufactured by M. Jules de Brunfaut, in Paris, and differ from the articles of this kind hitherto produced, in being much finer, more tenacious, flexible, and durable. Some of the glass-wool is said to be as fine as a spider's web, and so flexible that it may be used as thread.

Preparation of Oxygen from Sulphuric Acid.

The process of Messrs. Clomadena and Moret consists in impregnating pieces of pumice stone with sulphuric acid, and afterward expo-

sing them to a red heat. The acid vapors thus generated pass through several retorts filled with pumice stone and kept at a white heat. Sulphuric acid is decomposed into sulphurous acid and oxygen. The mixture is conveyed through water, which leaves the oxygen comparatively pure.

Composition of Meteorites.

Messrs. Wöhler and Cloez have proved by analysis that certain meteorites contain carbon, hydrogen and oxygen, forming substances similar to some organic bodies of terrestrial origin. From the meteorite Orgueil, M. Berthelot has obtained a notable quantity of hydrocarbons similar to those found in petroleum.

Nitrous Oxyd for Neuralgia.

Dr. G. Q. Colton, who has successfully administered laughing gas to about 34,000 persons, for the purpose of performing dental operations without pain, and who, by persistent personal efforts in Europe, has at last succeeded in introducing the use of this gas for similar purposes in Paris and London, asserts that he has repeatedly cured the most severe cases of neuralgia by allowing the patient to inhale the gas. In many instances persons afflicted with asthma have been greatly relieved. If these two terrible maladies can be cured, or even partially controlled by laughing gas, we hope the medical faculty will recommend its use with as little delay as possible.

Blasting Granite.

A mass of sound stone fifty feet square and twelve feet in thickness, was recently moved some inches from its natural bed in the granite quarries near Penryn, England, by the explosion of fifty pounds of blasting powder, confined in a hole twelve feet deep by six and one-half inches bored in the rock. Estimating the weight of fifteen cubic feet of granite at one ton, the whole mass, containing 19,200 cubic feet, weighs 1,280 tons.

Terra-Cotta Cisterns.

It is said that cisterns made of glazed terra-cotta are rapidly coming into use in England. They are as valuable as those made of slate, and are much cheaper.

STEAM ROAD-ROLLER.

The huge machine used for leveling the carriage-way in some of the streets of Liverpool, England, has so injured the network of gas and water-pipes underneath, that the corporate authorities find that they must greatly decrease its weight, or cease using it altogether in certain parts of the town.

THE BLEACHING OF WOOD PULP.

The objectionable results of the process of bleaching by chloride of lime are, that any excess of the chloride has a tendency to produce a yellow tint, that all strong acids are apt to turn the paste red under the action of the sun, or sometimes solely by the presence of moisture; that the smallest trace of iron will blacken the paste in a short time. These difficulties have been obviated by M. Orioli, of Paris, who mixes with every 100 kilogrammes of wood pulp 800 grammes of oxalic acid, which serves the double purpose of bleaching the coloring matter already oxydized, and of neutralizing the alkaline principles favorable to oxydation ; two kilogrammes of sulphate of alumina are added, forming with the coloring matter of the wood a nearly colorless lake, which enables the brilliancy of the product to be heightened.

ENAMELING OF IRON.

The process of enameling cast or wrought iron most commonly used is to cover the previously well cleaned and smooth surface of the metal with finely pulverized enamel or glass, and subject it to a high heat in a muffle or oven, by which the fused coating is made to adhere more firmly to the metal. To secure this adherence a new plan has been proposed in Germany by Mr. Ballouhey, which is to first oxydize the surface of the iron, forming the protoxyd and sesquioxyd of iron by pouring upon it the hot liquid material forming white glass, or by placing the material in powder upon the metal and vitrifying it by heat. In this case the silicate of iron is formed which is said to unite more firmly with the metal. This plan may be an improvement over the old one, but it is plain that the great difficulty in adherence arises from the difference in the expansibility of the metal and the enamel, and is one that cannot be entirely obviated.

MARKET APPROACHES.

A correspondent of *The London Builder* suggests that every new market erected should practically carry out two leading principles;

the one to command supply, and the other to make the heavy traffic disappear from the surface, which, he says, can best be done by having beneath the markets underground railway branches connected with all the main lines, so that the products from a great distance can be brought to the stalls without transhipment, and in the same manner articles purchased at the market could be forwarded directly therefrom to any part of the kingdom by rail. It seems a plain proposition that there cannot be too many approaches to a great public market; and there are many other improvements of a scientific and sanitary character yet to be made in all structures of this class.

PAPRYOXYLE.

This compound, used as a substitute for pyroxyline in photograghy, is perfectly soluble in a mixture of alcohol and ether. The absolute absence of structure produced by a complete solution is said to increase the sensibility of the film. Dr. Liesegang publishes in a foreign journal his process for making papyroxyle. He plunges fine tissue paper into a cold mixture of equal volumes of sulphuric acid of the usual strength and nitric acid of 1.40 degrees. The paper remains in the mixture until a portion of it can be completely dissolved in a mixture of equal parts of alcohol and ether. Different varieties of paper require slightly different proportions of acid to form the mixture. The paper on being withdrawn from the mixture is hung over strings, and may be completely dried in half an hour.

THE BAHAMAS HURRICANE.

Mr. John H. Redfield of Philadelphia, son of the late William C. Redfield of New York, author of the theory of cyclones, has made a diagram of the directions of the wind at thirty-four different points at noon on the first day of October, 1866, from observations collected by Governor Rawson, W. Rawson, C. B. and Captain W. H. Stuart, Bahamas. From the letter of Mr. Redfield, accompanying the diagram, we learn that at the time mentioned the center of the hurricane was but a few miles southeastward from Shroud Cay, the wind at that Cay being from the northeast until one P. M., when there was a lull of an hour, followed by a gale from the southwest. The line of progress of the axis of this storm, after leaving Turk's Island, seems to have been almost identical with that of the Antigua hurricane of August 22d, 1848, which also passed over the Bahamas, beginning its easterly recurvature also about latitude twenty-eight

degrees or twenty-nine degrees, and pursuing its northeasterly track at least to longitude thirty-five degrees and latitude forty-five degrees, occupying twelve days in its journey.

Worms Infesting the Brain of Birds.

Dr. Jeffries Wyman has communicated to the Boston Society of Natural History a description of an animal parasite, the thread worm, found in the brain of seventeen out of nineteen specimens of the snake bird, or water turkey, shot in Florida. The presence of these parasites in the cranial cavity of the *Anhinga* seems to be its normal condition; yet nothing is known of the manner in which the embryo finds its way into the bird. Dr. Wyman says parasites have occasionally been found infesting the brain or its membranes in man and animals, but far less frequently than in other regions of the body. The species, referrable chiefly to four genera, are confined almost wholly to man and domestic animals, such as sheep, reindeer, dromedary, horse and ox; and among the wild animals, to the chamois, roebuck, and a few others. That they have not been more frequently seen in wild species is doubtless due to the fact that but few brains of these have been examined.

Effect of Light on Mineral Oils.

Herr Grotowski, of Halle on the Saale, Prussia, has made some remarkable communications on the new property of hydrocarbon oils, which was discovered by him. In exposing various kinds of such oils to the rays of light in glass balloons, he invariably found that they absorbed oxygen, and converted this gas into its allotropsic condition, ozone. It was further ascertained that even the air was thus ozonized in well corked vessels, the effect being to some degree dependent upon the color of the glass. The respective results were marked down after the space of three months. But, before enumerating them, it will be proper to remark the term protogen is applied to oils from peat or bituminous coal which distil between 212 degrees and 552 degrees Fahrenheit, having a specific gravity between 0.795 and 0.805. The name "solar oil" is given by the Germans to oils having a specific gravity of from 0.830 to 0.835, and distilling above a temperature of 550 degrees Fahrenheit. The former are burned in lamps adapted for that object, the latter in Argand and Carcel lamps. The observations of Herr Grotowski are the following:

1. Solar oil and photogen, which were stored in barrels and cis-

terns, lined inside with iron, remained free from ozone, and could be completely burned.

2. Photogen and solar oil, kept in balloons of white glass, wrapped up in straw, showed traces of ozone, but burned well otherwise. Both the color of the oil and that of the cork were found slightly changed.

3. Photogen and solar oil, in balloons of white glass, painted black, showed traces of ozone. The oils were less changed than those noted in number two. The corks were not bleached.

4. Solar oil and photogen which had been kept in unwrapped white glass balloons, were found to be strongly ozonized. They burned very badly, charred the wicks, and nearly extinguished the flame after burning for six or eight hours. The solar oil was turned strongly yellow, and showed an increase of 0.003 in its specific gravity.

5. Solar oil which had been exposed to the light in unwrapped balloons of green glass gave strong indications of ozone. Though the wick became charred, the oil burned quite well and was little changed in color.

6. Solar oil in balloons of green glass, painted black, was found to contain some ozone, but it burned perfectly well. That in green balloons, wrapped in straw, showed about the same results.

7. American kerosene which had been exposed to light in balloons of white glass became strongly ozonized, so much so that it scarcely burned. The formerly bluish-white oil had assumed a vivid yellow tint, and its specific gravity was found to have increased 0.005.

8. American kerosene which had been kept in the dark for three months did not show any ozone and burned perfectly.

The oils had been exposed to light from April to July, 1868. Those which had become strongly ozonized were changed in odor also, and the corks had become bleached, as if attacked by chlorine, while those in balloons, containing unaltered oils, were entirely unchanged in that respect.

After the discussion on the scientific items several new inventions were exhibited.

New Stove Pipe Joint.

Mr. Faint, of Canada, exhibited a stove pipe having a screw-thread on the ends, similar to that of fruit jars, by which the ends of the pipe can be screwed together, making a strong and tight joint.

NEW CARPET BEATER.

Mr. John Ferguson exhibited a model of his carpet beater. By turning a crank, a number of whips are made to strike the carpet, giving an elastic, yet effective blow.

Extracts from the Hon. Wm. J. McAlpine's notes on the trial of guns in England were read, which have not been furnished for this report. The subject drew forth some debate, after which Mr. Lewis Masquerier, of Green Point, L. I., read the following:

PLAN FOR A BRIDGE ACROSS EAST RIVER.

I suggest the plan of a floating bridge across East river, to rise and fall with the tide. Let it be built of an appropriate width, in sections hinged together, and supported by three piers in the center of the river. Let a floating turnpike or turnstile draw-bridge with four cross-arms, turn upon a center-post in the central pier, for vessels to pass through. This turnpike draw may be constructed to turn round with the force of the tide, always in the same direction, with the aid of additional power and be stopped at intervals. The arms of the draw-bridges may have circling passways, so that vehicles can reverse their directions. With large iron posts in each pier, the whole can rise and fall with the tide. This turnstile and the ends of the bridges may be guarded with rollers and soft materials to break the force of the vessels and to let them pass through more easily. Separate passways will accommodate both passengers and vehicles going each way. This floating bridge may be braced on both sides with anchors fastened in the solid stone or otherwise in the river bottom. The car lines should not cross bridges, but give passengers the healthy exercise of walking over. If this plan has any merit, the engineers can make out the details for its construction.

The plan of Mr. Masquerier did not meet with general approval.

SAFE PETROLEUM OIL FOR ILLUMINATION.

The chairman read an interesting sketch of trials made by Profs. Horsford and R. Ogden Doremus to test the value of an article termed "astral oil," but lately brought to the notice of the public.

This oil is prepared from petroleum by improved processes; and as the subject of the production of an oil much less dangerous than those in common use is one of the utmost importance to all who employ lamps for illumination, the mode taken to ascertain whether any of the more volatile and dangerous products of petroleum were

present in the astral oil is here appended. The process was carried on with Regnault's apparatus for fractional distillation with the following results: One hundred cubic centimeters of the "astral oil" were employed in the experiment. No perceptible odor reached the receiver, in a period of thirty minutes, at a temperature of 125 degrees Fahrenheit. In the following thirty minutes, at 145 degrees Fahrenheit, a perceptible odor was observed, but no liquid distilled. At the temperature of 175 degrees, in the same time, a single drop was condensed. At 212 degrees Fahrenheit, for thirty minutes, the distillate amounted to one-third ($\frac{1}{3}$) of one cubic centimeter. At 250 degrees Fahrenheit, for thirty minutes, the distillate amounted to four (4) cubic centimeters; and at 300 degrees Fahrenheit, for thirty minutes, to fourteen (14) cubic centimeters; which results tabulate as follows:

30	minutes	at	125	deg.	Fahr.	No odor.
30	"	"	145	"	Fahr.	Perceptible odor, but no liquid.
30	"	"	175	"	Fahr.	A single drop.
30	"	"	212	"	Fahr.	One-third cubic centimeter.
30	"	"	250	"	Fahr.	Four cubic centimeters.
30	"	"	300	"	Fahr.	Fourteen.

The results of these experiments showed that the flashing point might be fairly stated at 125 degrees Fahrenheit, and the burning point at 145 degrees Fahrenheit. These tests, furthermore, led to the conclusion on the part of those familiar with them that the common methods of testing the inflammability of burning oils is quite defective, and that new instruments for the purposes indicated should be invented to meet the growing neccessities of the day; it being essential that the element of time should always be taken into consideration in determining the flashing and burning temperatures of samples.

The oil sold under the name of astral oil is that manufactured by Mr. Charles Pratt, of New York city. He puts it up in five-gallon cans, hermetically sealed, so that the contents cannot be tampered with or adulterated by the dealers through whose hands it may pass, the purchaser of a can being thus guaranted an oil safe and superior. A discussion of some length and considerable interest sprang up concerning the use and characteristics of the common petroleum oils, in the course of which Dr. Parmelee spoke as follows:

The series of experiments recently made by Professors Horsford and Doremus prove several points which have been brought prominently before the Polytechnic on several occasions during the last

five years. And it is unfortunate that facts often pointing to important public wants may be stated and reiterated before scientific bodies without attracting the general notice which should from their natures be given to them. Such was the case with the subject to which the report just read relates.

When the Board of Health became impressed, from the number of accidents constantly occurring, that something was somewhere wrong, they requested their chemist, Dr. Chandler, to investigate the subject, and he failed to find, out of a hundred or more samples promiscuously purchased in the market, that any of these samples came up to the requirements of a safe and good oil, with the exception of one which had been received some time previous as a sample for scientific examination. The Board of Health made public this condition of the trade, and everybody was talking about some way to provide a remedy. The mode adopted by our government for determining the safety of petroleum oil does not compare in accuracy or convenience with those for testing other articles of commerce; and, as the experiments show, varies considerably with different instruments, though constructed on the same principles.

In answer to the request to explain the philosophy of kerosene explosions, he stated that gasoline, as it is called, is the lightest portion of the petroleum, and is volatile at the common temperature of our atmosphere; so that whatever quantity there may be of this in an oil it will escape if placed in a warm room or during unusual warm weather, and, mixing with atmospheric air in the proportion anywhere between seven and twenty per cent, constitutes an explosive mixture. If less than seven per cent, ignition forms a blue flame; if more, a continuous burning also takes place; but no explosion occurs.

This is also true with our common burning gas, and many other products when mixed with air in gas form. If a glass sphere be filled with either of those products in gas form, and wires be so adjusted as to pass an electrical spark through it no explosion or ignition will take place. But if air has been mixed with it, within the proportions stated, and the spark passed through the mixture, a violent explosion follows, scattering the glass into thousands of fragments. To say that any petroleum oil is absolutely as safe in every respect as whale and lard oil is not really true. It may be, and is prepared of so uniform quality that no portion of it will volatilize at a temperature likely to occur in the legitimate use of it; but, if a lamp is broken, for example, the oil it contains is scattered over the table, floor, or

person holding it; if it is petroleum, immediate ignition may take place, and the heat of its burning is so intense that everything combustible is soon involved in flames. On the other hand, if whale or lard oil is thus scattered it is comparatively slow to ignite, and slow to burn, giving ample time for those present to prevent the occurrence of damage.

The superior light afforded by petroleum is the great inducement for its use, and when properly prepared and refined it is not unpleasantly odorous, and the only precaution requisite is to avoid breaking lamps, spilling the oil, and thus setting fire to the premises.

Mr. C. E. Emery said when a lamp is lighted in a warm room, the temperature of the gas within the tube of the lamp is high. Now when this lamp is taken into a cold room, the gas is condensed, so as to take in some of the outer air, which mixes with the gas; and again when the lamp is brought back to the warm room, this explosive mixture is forced out, and is apt to cause an explosion.

After a lengthy but interesting discussion the Association adjourned to meet again in one week.

March 11, 1868.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

The attendance at the meeting was unusually large, and it was quite evident that the room in which these meetings are held is entirely too small for the purpose of the association. The chairman opened the proceedings by reading a series of exceedingly valuable and interesting notes on the scientific novelties which have been recently brought forward.

Nitrous Oxyd for Neuralgia.

The first item related to the recent discovery of Dr. G. Q. Colton, of New York, who claims that nitrous oxyd, or laughing gas, is a specific for neuralgia. The doctor has successfully administered the laughing gas to 34,000 persons, for the purpose of performing dental operations without pain, and, by persistent personal efforts in Europe, has at last succeeded in introducing the use of this for similar purposes in Paris and London. In many instances persons afflicted with asthma have been greatly relieved.

Dr. L. Feuchtwanger remarked that chloroform is unquestionably a better anæsthetic than nitrous oxyd. Owing to the short duration

of the effects produced by nitrous oxyd, it is doubtful if this gas can be made to replace chloroform in surgical operations.

Dr. D. D. Parmelee.—It is perhaps not generally known that chloroform alone is not now used in our best hospitals. The effects of chloroform are such that the patient is frequently beyond recovery before any indication is given of its deleterious effects. For pure chloroform, has been substituted either ether, or a mixture of ether and chloroform.

Extra Digits.

Under this title, Doctor Burt G. Wilder, Professor of Zoology in the Cornell University, has presented many curious and interesting facts concerning the occurrence of supernumerary fingers and toes. In his memoir he gives an account of 152 cases, and is anxious to receive any information which may be sent to him.

Mr. A. E. Kendal remarked that he had known a number of cases of six fingers, and in the case of one family this feature seemed to be hereditary.

Dr Vanderweyde stated that he had known a case in which but one finger existed in the hand, the bones having grown together.

Zirconia Light.

The oxyd of zirconium has been successfully substituted in France for lime and magnesia pencils in the hydro-oxygen light. Zirconia had been previously and often subjected to the action of the hydro-oxygen blow-pipe, and as it was found to remain entirely unaltered, its use for the purpose of procuring light has been patented. The inventor obtains his zirconia by transforming the native silicate of zirconia into the chloride of zirconium, and then substituting oxygen for chlorine in the latter compound. The zirconia thus obtained is first calcined, then moistened and poured into moulds, with or without other agglutinant substances, such as borax or clay. As zirconia is more expensive than lime or magnesia, it is proposed to make the exterior only of the pencils of zirconia, the interior being composed of cheaper material.

Dr. Feuchtwanger.—The great difficulty in this case will be the expense of the zirconia. Zirconia is one of the rare minerals, being found in but few localities and not very plentifully in these.

In reply to a question relating to the quality of the light, Dr. Vanderweyde said: The zirconia light is nothing new. It is

merely the old Hare or oxy-hydrogen light with zirconia substituted for lime or magnesia. Zirconia has been used before for producing light, and so have most of the earths, but the present improvement consists in a better method of preparing the zirconia. . Lime gives an intense light when placed in the flame of the oxy-hydrogen blow-pipe, but it crumbles away. Different specimens of lime are of different values for this purpose. Some are almost worthless, while some good pieces of lime will last for a long time. The lime from Glen's Falls has been found to be the best in this country. But magnesia is better than lime, and zirconia is still better than magnesia, as it not only gives a very intense light, but it lasts a long time.

Mr. John Phin.—The probability is that the quality of any pencil of lime will depend upon two things. Its freedom from such foreign substances as tend to render it fusible, and its freshness. If the pencil is not freshly burned; if it has become hydrated in the slightest degree, it will fall to powder at the first touch of the oxy-hydrogen flame. In my experience, whenever the light begins to fail, I look with confidence for evidences of fusion on the surface of the pencil. It is well known that various substances, such as silica and some alkalies and metals, render lime very fusible when they are mixed with it.

A gentleman present, here asked if the new light could be made so steady and so easily used that it would serve for ordinary purposes of illumination.

Dr. P. Vanderweyde.—There is no diffculty in the matter if the apparatus be in charge of a good chemist. The lime light can be maintained for hours, if the gases are regularly supplied and the apparatus properly attended to. But the ordinary attendants of lighthouses, etc., are not chemists, and cannot manage the apparatus.

Mr. T. D. Stetson.—It is strange that this light, invented by Dr. Robert Hare of Philadelphia, should still be called the Drummond light. This name was given to it by the English, who have not yet found out that we Americans can do anything, and have not yet discovered, or at least have not yet published in their books, that Morse had anything to do with the telegraph, or Field anything to do with the Atlantic cable.

Mr. J. K. Fisher.—The lime light was discovered by Dr. Hare, of Philadelphia. Goldsworthy Gurney used it and called it the "Bude light," and Lieutenant Drummond used it as a signal in the great

English survey, and it was called the Drummond light. It should be called the Hare light.

Mr. John Phin.—If my memory serves me right, the Bude light was not a lime light at all, but a light produced by sending a stream of oxygen through the center of an Argand lamp. The name was derived from the residence of Mr. Gurney, in the south of England. Afterward it was applied to the illumination of the British Houses of Parliament, the stream of oxygen being passed through the center of Argand gas burners. But it was found difficult to regulate it and it was abandoned.

Mr. J. K. Fisher.—I am very much surprised at this, for I understood that a stream of oxygen passed through the center of an Argand burner would *diminish* the light rather than increase it. Dr. Vanderweyde has, if I recollect aright, exhibited some experiments before the club which go to prove this. By passing too much air through the center of an Argand burner the light is diminished.

Dr. Vanderweyde corroborated the views of the last speaker, and thought Mr. Phin must have made a mistake. He gave a minute description of the mode of operation of the Drummond light, and two kinds of apparatus which he employs for producing it, and promised to bring the apparatus to the club next Thursday night.

Mr. J. Phin.—There cannot be any mistake about what the Bude light was. This is a mere question of history and fact. All writers on the subject will tell you that the Bude light was produced by the combustion of a hydro-carbon, either oil or gas, in the presence of pure oxygen. As to the possibility of producing an intense light in this way there can be no doubt, as I have performed the experiment many times myself. It is no doubt true that too much oxygen or too much air will diminish the light. Hence, when we mix gas with air, and then burn it, we find that it gives no light. This is illustrated in the Bunsen burner, or, to take a more common object, the gas stoves used for heating and for cooking. But it is also true that the intensity of the light depends upon the degree of heat produced in the flame. Hence, the fact that it requires the intense heat of the oxy-hydrogen flame to make lime luminous; but, if we could get the same degree of heat by the use of common air as by the use of oxygen, we would get an equal amount of light. Now, the reason why common air fails to produce the same intense heat that oxygen does, is this: Common air contains a great deal of inert matter, nitrogen. This nitrogen has to be heated to the same temperature as the

burning gases, and consequently the temperature of the flame is lowered; the same amount of heat will evidently impart a higher temperature to one pound of material than it will to five pounds, just as a kettle half full will boil more quickly than a kettle entirely filled. A very ingenious gentleman of western New York, Dr. George H. Smith, acting on this principle, adopted the plan, using common air and common gas for producing the oxy-hydrogen light, but he heated the gases before bringing them together. In this manner he attained a starting point so far in advance of that secured by the previous methods that the final temperature given out by the flame was abundantly capable of producing an intense light. In the Bude light, the temperature of the luminous portion of the flame is increased, provided there be not introduced so much oxygen as will combine with all the luminous material of the flame before its light giving properties are evolved. Where oil lamps are used, the manipulation is easy, but where coal gas is employed, the relative pressures of the coal gas and oxygen must be carefully regulated, or failure is the result. If Dr. Vanderweyde should bring a supply of oxygen to our next meeting, I will try to reproduce the experiment.

ALUMINIUM BRONZE.

This beautiful alloy, which closely resembles gold, and which is composed of nine parts of copper with one of aluminum, is rapidly making its way in the arts. M. Dumas stated to a late meeting of the French Academy of Sciences that this bronze was now successfully used in various kinds of mechanism, especially in saws driven by steam power, which saws, although much thinner, lasted a much longer time than those of steel. It has also been applied with great success to the construction of journals in machinery intended to be run at a high speed.

Dr. L. Feuchtwanger presented a specimen which he had carried in his pocket for some years.

VALUABLE PRESERVATIVE PREPARATION.

Although the useful properties of carbolic acid are well known, its use has not been extensive on account of its objectionable odor. To remove the odor, Dr. Harris, health officer of New York, recommended camphor. Two parts by weight of gum camphor may be added to one part of carbolic acid in crystals. These solids, on being rubbed together for a few minutes, form a liquid. It is a pow-

erful disinfectant, but must not be applied to the skin unless very greatly diluted. When the preparation is required to prevent the ravages of insects it may be more conveniently used in a solid form, which may be obtained by adding whiting to the liquid. Ladies will find the presence of this powder very effective in the preservation of furs.

Dr. Parmelee suggested that there must be some mistake about the formula given for the preparation of the new article. Solid carbolic acid is an article never seen in the New York market, being altogether too expensive on account of the very great trouble involved in its preparation. Unless some way of using the liquid acid could be devised he did not think that the discovery promised to amount to much.

Dr. L. Feuchtwanger: Why use carbolic acid when permanganate of soda is so much superior. A body was recently sent from this city to the south, and kept in a state of perfect preservation by the occasional application of a solution of permanganate of soda. Solid carbolic acid undergoes a change by keeping, becoming red, and this change renders its use unpleasant.

The chairman thought that the doctor was laboring under an error with regard to the superior virtue of permanganate of soda. Experiments have proved that carbolic acid is superior to all other disinfectants. Sulphurous acid and the sulphites stand next.

Dr. Vanderweyde here remarked that carbolic acid had been used in some experiments for the preservation of animals by suffocating them in a room filled with the vapor of carbolic acid. The plan succeeded well on a small scale. The vapor penetrated the flesh very completely, affecting even the most minute fibrils. It was tried first with a chicken, then with a sheep, and finally with a bull. It worked very well with the chicken; succeeded tolerably with the sheep, but the bull gave a good deal of trouble. He became rather unmanageable before he succumbed. A question here arose as to the peculiar action in the case of Dr. Harris' preparation. Does the camphor merely neutralize the order of the carbolic acid, and does carbolic acid neutralize the odor of the camphor? It was a general impression that the odor of the carbolic acid is fully neutralized, but no information was given in regard to the odor of the camphor.

Mr. T. D. Stetson made some general remarks in regard to the distinction to be maintained between antiseptics and disinfectants. Salt is an antiseptic, for it prevents putrification. Carbolic acid is a

disinfectant as it destroys, or, at least, neutralizes contagious infection.

Gun Cotton.

This material seems to be attracting public attention as an explosive agent in mining operations. The principal objection to its use, its liability to spontaneous decomposition, it is said, has been removed by the use of a weak alkali, and it has been successfully employed in the form of compressed charges. Messrs. Abel & Brown, of the Royal Arsenal, Woolwich, the gentlemen who introduced these improvements, have recently made a still more important discovery. In experimenting with nitro-glycerine and gun cotton combined, it occured to them to try the detonating fuse in exploding gun cotton alone. The results showed that gun cotton exploded in this way has even more destructive force than nitro-glycerine. A detailed account of these experiments has not yet been made public; but if the reports which have reached us are correct, the discovery will be of great importance to mining engineers.

Dr. D. D. Parmelee.—I do not know that any explanation can be given of the strange facts here announced. We know that if a powder magazine should explode, any other magazine existing in the vicinity will be likely to explode too. If a little of any of the fulminates be exploded, all the other packages of fulminates in the neighborhood will explode. This is one of the circumstances which render the use of fulminates so dangerous.

Mr. J. Phin.—It is announced that the peculiar detonating or fulminating property, which is described in the article read by the chair, may be propagated even through explosive material which is not confined. Thus it is said that if a train of gun cotton be laid on the floor, and one end of it be ignited by some sharply explosive substance, the whole of the cotton will explode with great violence, whereas if it be simply fired with a light or a flame it will burn quietly. The action of various fulminates was then discussed, and the well known *pulvis fulminans*, a preparation which has been known for centuries, was adduced as an illustration of the subject on hand. When simply fired it fizzles away, burning slowly and quietly; but if heated until it melts, so that the particles can all unite at the same moment, it explodes with terrific violence, more resembling the action of the metallic fulminates than the operation of a substance composed of materials resembling those which enter into the composition of gunpowder.

Dr. Vanderweyde.—The property which confers its great value upon gunpowder is that it cannot be exploded by ordinary concussion, and it is even difficult to ignite it with a flame. There is a common lecture-room experiment which I have often performed and it is this: I have taken a basin of alcohol and set it on fire, and then taken a handful of iron filings mixed with gunpowder and shaken them into the flame. The filings will burn and the gunpowder will not. Iron is actually more combustible than gunpowder.

Mr. John Phin.—I have tried the experiment described by Dr. Vanderweyde, and it succeeds perfectly. There is another experiment which illustrates the same thing. I have strewed a train of gunpowder on a board for a length of two or three feet and then crossed it at right angles with a train of fulminating mercury. On firing the train of powder at one end it burns slowly up to the fulminate, which explodes and blows the powder all about. In general the powder is extinguished at the crossing of the train of fulminate, and the part of the train of powder which lies beyond this point does not burn.

Zoological Discoveries in Madagascar.

Recent explorations of M. Grandidier prove that, at the time the island was inhabited by the gigantic dodo or epiornis, it also possessed certain huge pachydermata, strongly resembling one of the most remarkable African species, viz.: A kind of hippopotamus. The remains of about fifty hippopotami, mingled with those of the dodo, were found in a marshy district on the west coast of Madagascar.

Basement Floors.

Professor Rolliston, of Oxford, in a communication to the London *Lancet*, calls attention to certain important points which the study of recent sanitary literature and of mechanical house building has impressed upon his attention. The most important is that relating to floors and foundations. It seems to be clearly made out that the interposition of a layer of impervious substance, of whatever kind, so, that it be impervious, between the level of the ground water in the soil, and the floor of the house built upon it, confers upon such a house an immunity in cholera epidemics. Facts in support of the truth of this statement are contained in a recent paper published by Professor Pfeiffer; and Dr. Rolleston is of opinion that the indi-

cations they afford should lead us to extend, over the entire area occupied by a house, a layer of the same impervious materials which are put into the so-called "damp course" of the walls. Such a superficial stratum can be easily made by a mixture of gravel and gas tar. It would effectually prevent the rising of the watery vapor out of the damp soil, which the "aspiring" effect of a warm house does so much to intensify over the area which it covers. Where the doors and windows fit closely, the draft of chimneys is constantly acting upon the air in the soil covered by the house in the fashion of an imperfectly exhausted receiver, and what is thus drawn up must be more or less malarious. Dr. Rolleston refers further to the necessity of removing the subsoil dampness, as a preventive of consumption, as shown by the researches of Drs. Bowditch and Buchanan; and he remarks that there is some little difficulty in reconciling its attainment with the present system of sewerage, but notes, that at Lubeck, the ends of the sewers have been secured by surrounding the ends of the drain pipes with a layer of gravel.

Mr. T. D. Stetson.—This is a very important subject. It does not always happen, however, that a house with a moist foundation is an unhealthy house. I know a house in New England which is built over a spring of clear water, and the health of the inhabitants of that house has always been remarkably good. If I wished to render that house malarious I will tell you how I would do it: I would dam up that spring so as to have stagnant water in the cellar; I would plant trees all round so as to prevent the light of the sun from ever reaching the house, and I would build high and tight fences all round so as to cut off all circulation of air. Then I think I would have succeeded in making the house unhealthy.

Dr. L. Feuchtwanger then read a very interesting paper on breccia and other marbles, illustrating his remarks by some beautiful specimens, highly polished.

The Screw versus the Paddle Wheel.

Mr. J. K. Fisher read an article from Colburn's Engineering, in which were given numerous instances of the superiority of the screw over the paddle wheel as a means of propelling vessels. Mr. Fisher thought if the commercial question had been left to solve itself, and the paddle wheel steamers had not been aided by government subsidies, the screw would have driven them out of use. Attention was called to the advantage possessed by twin screws over single screws.

Mr. Fisher thought that this might be accounted for by the fact that in the single screw propeller the water from the propeller is driven against the rudder, and does not have clear way.

Mr. C. E. Emery thought that the reason why twin screws placed at the sides of a vessel are more effective than a single screw at the stern, is that the twin screws work in more solid water than the other.

Mr. J. Johnson presented his method of forming a tunnel underneath the East river. The subject has been fully discussed at former meetings.

Self-acting Alarm for Boilers.

Mr. Edwin Ferguson exhibited a model of his self-acting alarm for low water in boilers. The apparatus seemed to promise efficiency and durability.

March 18th, 1869.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

In relation to the first item of scientific news on "zinc in boilers to prevent scale," read by the chairman, Dr. L. Feuchtwanger remarked that he tried this method in 1835; he cast cylinders of zinc for this purpose. They were some six inches long, and suspended in the water.

Dr. P. H. Vanderweyde said that, if the zinc is in contact with the iron, it should have the opposite effect. Copper vessels have been plated with zinc to prevent this. So when zinc is in contact with the iron it has the opposite effect. Zinc is the most electro-positive of the common metals. The iron will be protected at the expense of the zinc. There was a patent granted some three years ago, for putting a plate of copper in the boiler, which keeps the boiler very clean; but, at the same time, the boiler is covered with the oxyd of iron, which slowly dissolves the iron. Zinc is a very active agent in producing galvanic currents. The zinc will prevent the iron from oxydation, but copper will have the opposite effect.

Mr. C. E. Emery stated that, if a piece of zinc is suspended in the water in a boiler, the pitting of iron of the boiler is prevented, and it stops galvanic action also.

POISONOUS COLORING MATTER IN HOSIERY.

Several remarkable cases of poisoning from wearing colored hosiery have been lately reported. The Paris *Les Mondes* states that M. Bidard, of Rouen, France, obtained from an Englishman a pair of stockings of lilac color, in which were woven circular stripes of bright red silk. The wearing of the stockings produced an intensely painful inflammation of the skin in circular lines around the limb. On analyzing the red silk in the stockings the coloring matter was found to be *corallin*, a new dye derived from carbolic (phenic) acid.

Mr. Webber, of London, recently brought to the notice of the sitting aldermen, the fact that the dye used in some of the gorgeous socks and other underclothing displayed in the windows of metropolitan hosiers exercises a very deleterious influence upon the skins of the wearers, producing irritation, and an eruption, and leading, if persisted in, to actual sores. The *London Lancet*, in commenting on this statement, adds, that last year during the time of the performance of the "Doge of Venice," at Drury Lane theatre, one of the *dansueses* applied to one of the metropolitan hospitals with an anomalous eruption affecting one foot, and exactly those parts which are covered by an ordinary dancing shoe. It was immediately perceived that the heat of the foot, where covered by the shoe, acted upon the dye of the stocking, which the patient stated was of a brilliant red color, and thus affected the skin; but the absolute immunity of the opposite foot was not readily intelligible, until the fact was avowed that the exigencies of the ballet necessitated another color on the other limb. In this instance, it appeared that the other performers who wore white hose beneath their colored garments escaped all injury; and the patient's skin recovered its normal condition shortly after adopting this plan. The manufacturers of the dangerous articles alluded to by Mr. Webber, have already taken steps to abate the evil. In reference to this subject, Prof. Wanklyn, of the London Institution, states in the *British Medical Journal*, that he had made an examination of the beautifully crystallized magenta dye, which was being manufactured by one of the largest coal tar works of Europe, and found it to be arseniate of roseine. The crude magenta cake and liquor found in the market soon after the first introduction of this coloring matter, was found to be largely contaminated with arsenic.

Dr. P. Vanderweyde remarked that the pure aniline colors are very harmless to the skin, but are poisonous if taken internally. It

is a great pity that manufacturers introduce dyes that are poisonous. For instance, those used on paper collars. These paper collars are covered with sulphate of baryta. All the baryta compounds are poisonous. Then again they are covered with zinc white, and many cases of sore neck are occasioned by this.

Iron Clads under Fire.

The *Anglo Brazilian Times* gives an account of the behavior of iron clads in an engagement with the Paraguayan batteries. To those who are studying the question whether the best defended vessels can resist the power of the best constructed forts, this following description of a rather small engagement may be of some interest: The iron clads first encountered the batteries of the enemy at Fortines Bluff, consisting of fifteen cannon in redoubts, seven of which were sixty-eight-pounders, one thirty-two, four rifles and four of unascertained calibre. Owing to the curve of the bluff, the fire of the cannon converged upon the narrowest part of the channel at a very short range. Two successive shots struck and shook the vessels, and did much damage, but the vessels continued to steam up at full speed, finding no boom or torpedoes, as anticipated. The second redoubt raked the two vessels from ahead, while the sixty-eight-pounders shook the plating with shots discharged within thirty yards. However, only fifteen shots struck, seven on the "Bahia" and eight on the turret and other exposed parts of the "Alagoas," owing to the haste of the enemy, who evidently supposed the whole division was coming up. The vessels passed up the river without further opposition, and, after bombarding the works of the Paraguayans for about four hours, the vessels returned. In passing the batteries again, the fire was very heavy. A ball entered the wheel turret of the "Bahia," killing the pilot, by which the vessel would have been unmanageable had not the engineer steered the vessel by means of the twin screw propellers. During the twenty minutes occupied in repassing the "Bahia" she received serious injury; for of the sixteen shots which then struck her on the port side, four smashed and transversed the plating almost to the water-line, so that, after anchoring, it was necessary to stop the breaches with pitch. No shot had before injured the plating of this vessel, but it could not resist the sixty-eight pounders sent at such short range. The "Alagoas" was struck eight times in both passages, and, in ascending, had her engine disabled four hours. The "Silvado" was struck twenty-nine

times, and received damages which, for the most part, could not be repaired with the means at the disposal of the division. One ball struck her a foot under water, and another two feet under water, at the junction of the plates, loosened both and stuck in the backing. The "Piauhy," "Barroso," and "Rio Grande" engaged the batteries, while the three before mentioned went up the river. The "Barroso" was not hit; the "Rio Grande" received two shots, and the "Piauhy" ten. The latter, toward the end of the engagement, had her turret disabled by a splinter, but the gun was brought to bear by aid of the twin screws. The *Times*' whole description of this engagement leads the reader to infer that iron clads cannot resist batteries under close fire. However, in this case, the vessels accomplished the work marked out for them. We have no plan of the construction of these iron clads; but we may here add a recent remark made by an American admiral, that with iron clads properly made, and enough of them, he would agree to pass any number of forts and land batteries.

Mr. Emery said that an iron clad ship that would be injured by a sixty-eight pound shot must be a very poor one. The smashing effect of our fifteen inch shells was greater with a slower velocity than one from a small gun at greater speed.

Dr. P. H. Vanderweyde remarked that he examined the iron clads when they came from Fort Fisher, and they were simple indentations in them. The effect could be compared with the blow of a small and large hammer. The small shot confines its effect to the place it strikes. A large shot gives out more force in proportion to its area.

Railway Apparatus for Receiving and Delivering Mails.

Mr. Freeman R. Sibley, of Auburndale, Mass., exhibited a model of his and L. C. Wade's new plan for receiving and delivering mail bags on railway trains, and spoke substantially as follows:

It has long been a desideratum that some means should be provided whereby mail bags, express matter, and the like could be delivered to and from express trains without stopping, thereby obviating the delay, exposure, and inconvenience incident to the usual method. Several means of accomplishing this result have been brought forward from time to time; but hitherto have been subject to inherent defects that have destroyed their usefulness and availability. The apparatus, however, represented in the accompanying

engravings having been successfully tested upon the Boston and Albany Railroad has proved an exception to the rule, and is now brought before the public by the inventors as an apparatus the value of which has been proved by the crucial test of use.

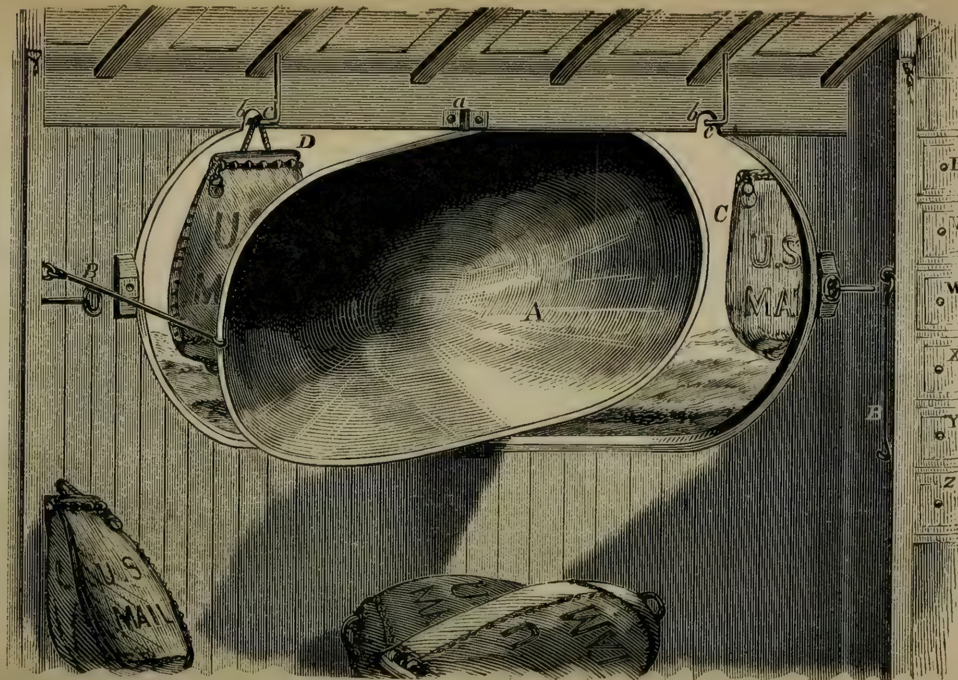
The larger of the two engravings is an external view of a mail car fitted with the invention, and the smaller is an internal view of the same on an enlarged scale, showing more in detail the working parts of the device.

In one side of the car, near the roof thereof, is formed an oblong opening, in which, on a vertical axis, is arranged a scoop, A. The shape of this scoop may be described as that of the one-half of an oval vessel divided longitudinally through its center. The pivots, *a*, by which the scoop is attached in place, are arranged at its center, close to its edges, and of course at the middle of the opening just described, in which the scoop is placed, as shown more fully in the smaller cut. At each end of the opening in the car, at its upper part, is a recess, *b*, through which passes the horizontal portion of an angular hook, *c*, the purpose of which will be presently explained. Attached by a staple to the inner surface of the side of the car, and adjacent to either end of the scoop, is a rod, B, furnished at its free extremity with a hook. By hooking the extremity of one of these rods upon the contiguous end of the scoop the scoop will be held in a position at an angle to the side of the car, as indicated in the above engraving. One or the other of the rods being used according as the car is moving in one direction or the other, that the end of the scoop which is foremost when the car is in motion projecting outward from the side of the car, while the opposite end, as a matter of course, projects inward as will be understood by a reference to the smaller cut.

In order to use the apparatus the mail bag, C, to be delivered to or deposited within the car, is suspened as represented in the larger engraving, upon a suitable hook, supported by a fixed post close to the track, at the same height from the level of the track as the opening in the car; this hook being at such distance from the track that when the bag is suspended therefrom it will be in the same line with the outwardly projecting portion of the scoop as the car advances. The bag, D, to be delivered from the car is suspended from that one of the hooks, *c*, behind the rear or inwardly projecting part of the scoop.

As the car passes along, the forward portion of the scoop passes outside of the bag to be taken aboard, and striking the bag pushes it

The bag C, to be received, being properly suspended on the crane at the station, the operator in the car sets the Scoop at the proper angle with the lever B; at the same time hanging the bag, D, which is to be delivered. When the bag, C, strikes the Scoop, it passes beyond the centre, causing the Scoop to close or shut up with such force as to throw off the bag, D, depositing it near where the other is taken, thus relieving the mail clerk of all care, exposure or danger. Bags of any size, form or weight, also Packages or Bundles of any dimensions, can be received and delivered. By this Apparatus the wear of mail bags and damage to contents are entirely avoided. The saving in bags alone will more than compensate the expense of Apparatus.



A, Scoop set for operation. B, Levers to keep the Scoop in position. C, Bag to be received from Crane, at Station. D, Bag to be delivered, suspended inside the car.
a, Centres or pivots on which the Scoop swings. b, Opening in the Car for the handle of the Bag to pass through. c, Sliding-bar for Bag to hang from previous to delivery.
e, Arm on back of Scoop to guide the Bag while passing from the Car.

from the hook, whereupon the velocity of the car causes the bag to strike the inclined surface of the rearmost part of the scoop with such force as to disengage the hook on the rod, B, from the rear end of the scoop, and to move such end forcibly outward until the scoop assumes a position parallel with the side of the car. This movement of the scoop, by bringing its forward end inward, throws the bag, C, inward through the opening into the car, and simultaneously with this the rearward end of the scoop in its outward motion strikes the bag, D, and pushing it from its hook, *c*, throws it outward to the ground. It should be mentioned that this expulsion or removal of the bag, D, from its hook is assisted by means of a small hook-shaped arm, against which the lower part of the bag rests when suspended, as just set forth; one of these small hooked arms being provided at either end of the back of the scoop for use as the car is going in one direction or the other.

To illustrate the success which has attended the introduction of this apparatus into actual use, and its merits as compared with apparatus hitherto devised, we append a sketch of its trial on the Boston and Albany railroad. "The method hitherto adopted has been to suspend the bags on cranes and snatch them with a hook. This, however, occasionally injured the bags, and at other times missed them, and they had to be sent by a later train. The new method was tested on a train going from Worcester depot. Bags were taken up at Newton Corner, Newtonville, West Newton, and Natick, and at Auburndale a basket containing a live dove, two bottles of wine, crackers, wine glasses, cigars, etc., was suspended and was easily scooped up while the train was proceeding at its average speed—thirty-three miles an hour. The dove was uninjured, and the bottles of wine were found intact. Wherever the bags were suspended at the proper distance the experiment was thoroughly successful."

This invention met with very general approval of members who expressed any opinion on the subject.

NEW CHECK BOLT FOR NUTS.

Mr. Chapman exhibited a check bolt, the invention of Mr. David Cumming, Jr. It consists of a copper wire placed in a slot in the screw, when the nut is screwed to the required place, the end of the wire turned over, which prevents the nut from shifting.

Mr. Dudley Blanchard said the only security we have to keep

nuts in order is watchfulness. A check nut is the most simple device we have.

Diagram of Colors.

Mr. John Johnson, of Saco, Maine, presented a diagram of the compositon of various colors. The subject of colors was selected for discussion at a future meeting.

Ice Machines in New Orleans.

Dr. P. H. Vanderweyde said he had recently traveled some 3,000 miles, and passed through eighteen States of the Union. At New Orleans, on last Friday, 1,000,000 pounds of ice was sold in that one day. While in New Orleans he inspected an ice machine which was in successful operation. This apparatus was worked by the ammonia process. There were six machines in operation, with fifty-two compartments, filled with distilled Mississippi water. These compartments are lined with ammonia pipes; in about a minute after the water comes in, it is converted into ice. They make 120 tons a day, which sells at four and five dollars a ton; each of the cakes of ice weigh some forty pounds; they are about two inches thick. The water is converted into ice, on an average, in one minute and a half. At the World's fair in London, the ammonia ice machine was first exhibited by Mr. Cary. It had two simple vessels, a large and a small one. It was called the alternative ice machine. No brass can be used about these ammonia ice machines, because ammonia attacks that metal. He had a gasoline ice machine which he was about getting into operation at New Orleans.

Communications between New York and Brooklyn.

The regular subject for the evening being reached, the chairman made a few introductory remarks concerning the necessity of action in a subject of much ulterior as well as present importance. The demands of the business portion of the community should be conceded in preference to those of the shipping interests; and, instead of reaching out to White Plains, population should seek the one hundred square miles of unoccupied land on Long Island, that lies within easy access from the City Hall. Sooner or later, homes must be provided in New York and vicinity for 5,000,000 of people, and, as in every other project of reform or advancement, agitation is necessary in this.

A gentlemen compared the probable results of damming the East river, with what had evidently occurred in times past in the case of the Harlem river. The channel would be filled up with deposits, and the outlet to the ocean be lost. We should not risk the advantages which we now possess for the sake of uncertain results of an enterprise like the dam proposed.

Prof. Vanderweyde explained at length the formation of currents through the East river, from the difference between the time of flood tide in the Sound and at other points on the shore of Manhattan Island.

Dr. Bradley favored a tunnel under the East river. The tunnel should have a level grade, and be reached at either end by elevators worked by steam power.

Dr. Hallock said that, with reference to the dams or causeways, no matter what the width of the passages left therein, slack water would be caused, and from this at the sides of the channel silt would be gradually deposited, which in the course of time would narrow and destroy the channel.

Remarks were also made by several others among the crowded audience who attended the meeting.

Prof. Vanderweyde stated that the North river has two outlets to the ocean, that of Sandy Hook and the East river. He was convinced that the filling up of the East river will improve the navigation of Sandy Hook. Twenty-five years ago there was a necessity for making a ship canal at North Holland on account of the river filling up.

The debate continued to a late hour, and it was evident that the meeting was of opinion that both the State and National Governments should institute a series of examinations and inquiries which would throw some new light as to the question whether the East river tide is the cause of the gradually filling up of the bay at Sandy Hook.

Phenol-Camphor Disinfectant.

Mr. O. G. Mason, exhibited a specimen of carbolic acid and camphor combined. The mixture is two ounces of gum camphor and one of carbolic acid in crystals which makes a liquid; from this was taken one ounce, and mixed with thirteen ounces of prepared chalk, making about one pound. The object of camphor in this compound is to destroy or neutralize the peculiar smell of carbolic acid when used for disinfecting and other purposes.

Dr. Parmelee said that it was well known that constantly breathing camphor is very injurious. Most people are not aware of the small quantity that will produce serious effects. This should be more generally known, if this drug is to come into general use.

The chairman remarked that phenol or carbolic acid has been the germ of numerous and decided improvements in many branches of practical science. It is death to all parasites, as they cannot resist the action of this acid. It is one of the best remedies for the foot-rot in sheep, as this disease is probably caused by a parasite. It has also been successfully employed in curing the scab in sheep. The sulphite of soda is now much used in the treatment of scarlet fever, which is believed to be caused by some minute organism, but experiment has not yet determined whether it is vegetable or animal. The trouble with this disease is that after the fever is conquered, the patient but half cured, for a long time evils often follow, such as deafness, catarrh, etc., which sometimes last for life.

Mr. J. Phin said that it seems that many of the lives of the lower order of animals are destroyed by sulphur. While it is conclusive to all the higher animals, it is destructive to the lower. The itching class find it a poison, while the higher forms of life find it an advantage. Sulphur is the only good remedy for mildew on grape vines. It does not form sulphurous acid by being in the open air. The sulphide of calcium has been found very effectual on vines.

Mr. T. D. Stetson stated that fresh burned charcoal has a very practical effect in arresting putrefaction. It has also a good effect when taken in the stomach. If fresh burned charcoal is mixed with the food of the horse, it will benefit the animal much; but, it is particularly of advantage to those animals that get their food in a half decayed condition.

The chairman remarked that charcoal is a deodorizer, but not a disinfectant. It is a deodorizer by its property of absorption.

ANALYSIS OF ZINC COMPOUND.

Mr. William E. Gifford stated that he had analyzed a piece of corroded zinc, shown at a previous meeting, which had been suspended in a steam-boiler to prevent corrosion. He found it to contain forty-three per cent of metallic zinc, and fifty-three per cent of oxydized metal, and the balance consisted of fatty acids.

Mr. C. E. Emery said this piece of zinc was suspended in a boiler, in order that the metal which was more readily oxydizable than the

iron should be corroded. The piece was one and a half inches square and five inches long. The oxydized portion was ninety-two per cent zinc. The curved shape this piece of zinc is common to all cases of oxydation.

Patent Laws.

Mr. Thomas D. Stetson spoke at length on the patent laws of different countries. The United States patents are the most neatly executed. We have the finest patent office in the world. It is built in the form of a hollow square, and covers two blocks. It has some 50,000 models, a great number of drawings, &c. About 200 patents are issued every week. The Patent office, as now managed, is a source of pride to every American. The English Patent office requires no models, and makes no examinations. With us, novelty, utility and improvement are the essentials that make a good patent. The English patents are elaborately made out on parchment, with a number of verbose legal formulas; with a waxen seal some five inches in diameter and one inch thick (Mr. Stetson here exhibited the seal). An English patent costs some eleven dollars, but the patent fee is now payable in installments. In France a patent can be had for a government fee, which has to be paid yearly. The American government patent costs only thirty-five dollars for seventeen years. Here it is very easy to procure a patent. Within a few years the regulations have been radically improved. A patent can be got through with all that is required in about twenty-five minutes. The system of examinations pursued here cause many bad patents to be rejected. We make one general round charge, and that covers all expenses. A Spanish patent will cost some $200. They are engrossed on single sheets of common foolscap paper, and merely stamped in the place of seals.

Artificial Illumination.

Dr. Vanderweyde briefly explained the theory and practice, lighting by means of the calcium light and the Argand burner. With this burner, he said, the more air admitted to it, the less gas is consumed; but, if too much air, the flame will become blue. The greatest luminosity at the smoking point; when the smoking just stops, the light is at its maximum. Zirconia, lime and magnesia are the three substances which are used in the hydro-oxygen apparatus for an intense light. The magnesium light is produced by simply burning that metal. Strips of magnesium metal are now used by photographers to take pictures in the evening. The doctor illustrated his

remarks by many interesting experiments. The following paper was presented:

On the Manufacture of Oxygen Gas.

Prof. C. A. Joy.—Although one-half, if not two-thirds, of the weight of the globe is made up of oxygen, yet a thoroughly cheap and practical method for the manufacture of this gas on a large scale has not been discovered. There is no want of oxygen compounds, but how to decompose them is a difficult problem. We propose to recapitulate some of the most important methods now employed, and from them our readers may be able to select those which will be most available.

1. The old historical method of heating the red oxyd of mercury and of driving off the oxygen contained in it, is given still in our chemical text-books, and is employed as a lecture room experiment. It is easily enough accomplished, but would be too expensive on a large scale. It may be worthy of note that the original burning glass which Dr. Priestley used in the first preparation of oxygen was brought by him to this country, and is now preserved in the cabinet of a college in Pennsylvania. One of Priestley's tubes for collecting the gas is in the possession of the eminent American chemist, Dr. Wolcott Gibbs, of Cambridge.

2. The chlorate of potash method is more frequently employed than any other. It is a curious fact that in nearly all of the establishments where an effort has been made to introduce a new way of preparing oxygen, all of the gas used for showing the value of the invention has been prepared from the chlorate of potash, and the excuse given is that "our works are not yet in running order, and cannot be until a sufficient amount of stock has been subscribed." After the stock is sold we usually hear nothing more of the invention.

For all purposes of the lecture room and laboratory the preparation of oxygen from chlorate of potash is the most convenient and economical. In order to ascertain the amount of oxygen we can make from a given weight of the chlorate of potash, we take the weight of the combining numbers and make a rule-of-three statement. For example, how much oxygen can be made from 100 pounds of the chlorate, 123, 5 : 48 : : 100 : X.

It is always well in actual operations to mix a little black oxyd of manganese with the chlorate to prevent the too rapid evolution of the gas.

3. The black oxyd of manganese, when heated in an iron vessel, will give off a portion of its oxygen, but the heat required is inconveniently high, and this method is rarely employed.

4. A very neat laboratory method is to heat the bichromate of potash and sulphuric acid together in a glass vessel; considerable oxygen is thus given off in a pure state. The proportions to be employed can be represented by the formula:

$$KO, 2CrO^3 + 4\ HO, SO^3 = Cr^2\ O^3, 3\ SO^3 + KO, SO^3 + 4\ HO + 3\ O.$$

Chrome alum is usually produced, and it is this mixture that is employed in the bichromate of potash batteries.

This method is valuable where the materials are cheap, but is not available on a large scale.

5. The action of sulphuric acid upon the black oxyd of manganese is somewhat similar, and may be represented by the following equation:

$$2MnO^2 + HO, SO^3 = Mn^2O^3, SO^3 + HO + O.$$

The oxygen obtained is likely to be impure, owing to the foreign matter in the black oxyd of manganese.

6. For a long time nitrate of potash or saltpetre was employed in the preparation of oxygen. The salt only requires to be heated gently to disengage the gas, but the difficulty is to regulate the heat so as to prevent the entire decomposition of the saltpetre. The method is not available and is pretty much abandoned.

7. The bi-sulphate of soda, the salt cake of commerce, when heated with the black oxyd of manganese, yields sulphate of soda, sulphate of manganese and oxygen gas.

$$NaO, 2\ SO^2 + MnO^2 = NaO, SO^3 + MnO, SO^3 + O.$$

This method could be employed in England, where many thousand tons of the salt cake are annually made, and where the consumption of manganese is very great. It is not available in America, owing to the cost of the materials.

8. The decomposition of water by means of a powerful battery gives both hydrogen and oxygen in a very pure state, but the cost of running the battery makes this method very expensive. It is not impossible that we may some day be able to accomplish the decomposition of water economically, and this result is highly to be desired, as large sums are now annually expended in experiments in this direction.

9. It is said that if sand be heated with gypsum, the sulphuric acid

will be displaced from the lime and afterward be decomposed into sulphurous acid and oxygen, and that silicate of lime will remain. We give this method without being able to state what the practical working of it would be. It has never been tried on a large scale, the nearest approach to a trial being in the manufacture of glass. The heat required to fuse silicate of lime alone is very great, and it is probable that oxygen would be liberated much below this point of fusion. If any of our readers try this method we should be glad to hear the results of their experiments.

10. A method recommended by Deville, and largely employed in France, is the decomposition of sulphuric acid by heat. At the Paris exhibition of 1867, the plan proposed for the accomplishment of this decomposition was to suffer the sulphuric acid to trickle down upon a highly heated floor of sulphate of alumina, and to pass the sulphurous acid gas through soda or magnesia.

The sulphate of alumina protected the bottom of the furnace and the incidental sulphurous acid was economized. There are few cheaper methods than this, especially if conducted in connection with sulphuric acid works.

It is a curious fact that although Deville recommends this method, he employs the old fashioned process of chlorate of potash whenever he requires oxygen for his laboratory experiments. It goes to show that a convenient apparatus for the preparation of oxygen gas from sulphuric acid remains to be invented.

11. Webster has proposed to heat one part of Chili saltpetre and two parts of crude oxyd of zinc to a point sufficient to accomplish the decomposition of the nitrate of soda. By this method caustic soda and oxyd of zinc are left in the retort. The same oxyd of zinc serves for any number of operations. There would appear to be no waste in this process, but the Chili saltpetre is too valuable for other purposes to admit of its employment for this.

12. It is sometimes required to prepare oxygen for medical uses, and for this purpose it is desirable to have a method for its evolution without the intervention of heat. By employing the binoxyd of barium, the bichromate of potash and sulphuric acid, we are able to liberate oxygen in considerable quantity as easily as we can obtain hydrogen from water by means of zinc and sulphuric acid; but the materials are expensive. The following equation represents very nearly the reaction that is supposed to take place:

$$3\ BaO^2 + 4\ HO, SO^3 + KO, CrO^3 = 3\ BaO, SO^2 + KO, HO, SO^3 + Cr^2O^3 + 6\ O.$$

This method is one of the most interesting, from a scientific point of view, as two kinds of oxygen, ozone and antozone, are liberated. According to Schoenbein, we obtain ozone from the chromic acid and antozone from the binoxyd of hydrogen, and these two conditions of oxygen unite to produce the ordinary gas.

13. By boiling a solution of bleaching powders in a glass flask, with a few drops of nitrate of cobalt, oxygen gas is copiously evolved. The cobalt salt is not consumed, as it acts by its presence.

This method works very well in a small way, as we have had occasion to prove in our laboratory. It is, however, more inconvenient than the employment of chlorate of potash.

14. Sulphate of zinc, at a high heat, yields oxyd of zinc, sulphurous acid and oxygen. In establishments where the zinc salt is produced from galvanic batteries, it is sometimes advantageously employed in the preparation of oxygen.

15. The permanganate of potash, when subjected to heat, yields very pure oxygen. This method could be employed in medical cases, but would be too expensive on a larger scale.

16. Schoenbein once exhibited to us an experiment in his laboratory which we have never seen attempted elsewhere. It may suggest a method for the preparation of oxygen on a large scale. When spongy ruthenium is plunged into chlorine water, oxygen gas is given off in large quantities, and this will continue as long as there is any chlorine present in the water. The hydrogen of the water goes to the chlorine forming hydrochloric acid, and the oxygen is set free.

Schoenbein was of the opinion that by passing a continuous stream of chlorine gas into a vessel containing water and spongy ruthenium, oxygen gas would be given off in great quantity. As the result of hydrochloric acid could be used for the preparation of chlorine gas, and as the spongy ruthenium is not all affected, the expense of this method resolves itself into the cost of the chlorine and the original outline for the spongy ruthenium. We can hardly hope to see this proof employed on a large scale; but in a small way it is certainly very interesting and instructive.

17. It has long been considered desirable to obtain oxygen either from the atmosphere or from water. The water methods have not proved practicable, and we will give three ways where the oxygen is derived from the air.

The French chemist Boussingault proposes to heat gently the oxygen of barium (baryta) in a current of air, by which it would be

converted into the binoxyd of barium, and then to drive off the oxygen at a higher temperature. It was supposed that the same portion of baryta would answer for an indefinite number of operations. It is found, however, in an actual experiment, that the pores of the baryta become stopped up, and that the operation ceases after a few trials. This objection has been remedied to a considerable extent by adding caustic soda, or manganese, to the baryta, and it is then said to be highly successful.

18. The subchloride of copper, when exposed to the air, absorbs oxygen, and this oxygen can be again dispelled by heat. The reaction can be represented by the the following equations:

Cu^2 Cl+Cu+air=Cu Cl+CuO, and Cu Cl+CuO+400 degrees Fahrenheit, Cu^2 Cl+O.

This process, recommended by Mallet, has been highly commended by scientific journals, and companies have been organized for working it. It is probably one of the best thus far proposed.

19. The method of Tessie du Motay, for the preparation of oxygen on a manufacturing scale from the atmosphere, by the intervention of caustic soda, black oxyd of manganese, and super-heated steam, has lately attracted a great deal of attention. A small working model of the apparatus required in its preparation was exposed at the Paris exhibition of 1867. The theory of this process is that the caustic soda of manganese in a current of dry air becomes manganate of soda and water, and that super-heated steam reconverts the manganate into caustic soda and binoxyd of manganese, and liberates the oxygen. The oxygen is separated from the steam by the condensation of the water. It is said that the same materials can be employed for the preparation of an indefinite quantity of gas. A company has been organized for the working of this patent in New York, and if they can succeed in manufacturing oxygen at a cheap rate, they will confer a great boon upon the community.

We have thus hastily described nineteen processes which are sometimes employed in the preparation of oxygen gas. We do not pretend to have exhausted the subject, but have simply aimed at comprising in one list the best known methods. The process from sulphuric acid, and the three latter methods, from the atmospheric air, must be regarded as the most important for application on a large scale. For laboratory use, and until better means are offered, the old way of preparing oxygen from chlorate of potash will retain its supremacy.

March 25th, 1869.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

Suspension Bridges.

The chairman exhibited a small section of the wire ropes forming the cable of the new suspension bridge at Niagara Falls. The specimen had been presented to the Association by the Hon. William J. McAlpine. The bridge has the longest span of any suspension bridge yet constructed. The cable consisted of forty-nine strands of the rope, like the specimen shown.

Dr. D. D. Parmelee remarked that the bridge has now been open for three months, and answers admirably the purpose for which it was erected. A curious fact connected with this bridge is, that the ordinary difference of temperature occurring during our seasons, causes an elevation or depression of nearly three feet in the roadway at its middle. That is to say, during cold weather, the roadway is three feet higher than it is during very warm weather.

Mr. J. K. Fisher said that iron wire is better than steel for such purposes. Iron is more ductile than steel. The most important property of the wire is its elasticity, whereby the wires expand, and thus every one of the wires is made to bear its share of the strain. Iron will stretch and steel will break, in the contraction of a bridge, from the effects of cold. If twisted too much, the cable will not be so strong.

It was stated that some cables have straight central wires, and the outer layers of the wires are laid spirally around them.

Dr. J. J. Edwards remarked that this system would not be so good, the twist gives elasticity.

Letter and Envelop made of Sheet Iron.

The chairman exhibited a letter he had received from Mr. Norman Wiard, which was written on sheet-iron, and inclosed in a sheet-iron envelop. It was made in Pittsburg. Similar letters have been exhibited before the Institute on former occasions. Careful measurement with a reliable micrometer, shows the thickness of the sheet-iron composing this letter to be $\frac{1}{500}$ of an inch.

Dr. Vanderweyde said a book, of which the leaves were sheet iron, was exhibited at the exhibition in London. It contained 300 leaves, and was two inches thick, showing that the English sheets were much thicker than the American. It was printed, and the printing

was accomplished by the use of elastic type, made of the same material that is used for the inking rollers of printing presses.

Mr. J. Johnson remarked that these sheets were probably rolled out, two or three together, that is, a pile of two or three, laid one on top of the other, was probably passed through the rolling mill at once.

Dr. Feuchtwanger said this was the way in which tin-foil is made; or rather it is more frequently rolled between large plates, but then tin-foil is much softer than iron.

New Rails for Railways.

Mr. Edwin Ferguson exhibited a rail of peculiar construction. It is so made that, when necessary, it may be inverted, and the lower surface made to perform the part of the upper surface. It is fixed in a sliding chair. The rail is made of iron, and case hardened or carbonized on the exterior.

Dr. D. D. Parmelee, after some inquiries in regard to the methods used for carbonizing the rails, said there is no known method by which large plates of iron can be carbonized, except by cementation. All the plans for plunging, etc., are humbugs. It is true that by various processes of case-hardening the surface can be rendered hard, but then it takes eight hours to penetrate one-sixteenth of an inch, and after that depth has been reached the process becomes still slower.

In reply to a question of Mr. Fisher, Mr. Ferguson stated that it cost forty dollars per ton to carbonize the rails. Mr. Fisher said this would make it altogether too expensive. Besides that, if the central ribs were taken away, there is nothing left except the old English rail.

Mr. Ferguson replied, yes, if the top and bottom is taken away, there will be nothing left at all. The old English rail cannot be turned over and again be reversed, and so utilize all the four edges; and it is well known that it is the inner edges of the rail that suffer most severely, as they come in contact with the tread of the wheel.

Dr. P. Vanderweyde.—It is a curious fact that all those substances which are best for case-hardening, contain nitrogen. One of the best substances for this purpose is prussiate of potassa; a little of this sprinkled on a piece of iron carbonizes the surface instantly.

Dr. D. D. Parmelee.—Yes, but the iron is carbonized to such a slight depth that it is good for nothing where there is much wear.

The Chairman presented the following notes on scientific progress:

On the Fuming of Certain Acids.

Mr. C. Tomlinson answers an inquiry in the London *Chemical News*: "Why hydrochloric acid fumes when let out into the air, while ammonia, which has a much stronger affinity for water does not?" From his communication we extract the following: "I took the specific gravity of the solution of ammonia, and found it to be 0.889. Twenty-four drachms of this were put into a flask, and heated over a spirit lamp. It at once entered into quick ebullition, and there was a great head of gas bubbles from which very large bubbles expanded and burst. The thermometer rose slowly to 100 degrees Fahrenheit. When the lamp was removed the boiling ceased instantly, but two or three rapid streams of small gas bubbles continued to be discharged for some time from black specks in the glass which acted as nuclei. When the temperature was at 160 degrees the lamp was removed, and the solution left to cool. It smelt of ammonia; the lamp was replaced, and no gas bubbles were given off until the temperature had again risen to about 160 degrees. The appearance of ebullition was less marked than before, and the temperature rose to 208 degrees, at which it became stationary (barometer 28.69) inches. When cold, only ten drachms remained of the twenty-four. The specific gravity was now 0.997. The liquid had a faint smell of ammonia, and a slight action on tumeric paper; but on putting the glass in another room, where the liquid could not re-absorb the ammonia, it lost, in the course of a few hours, all smell; it had no action on tumeric paper; it was, in fact, brought back to pure water. If a similar experiment be made with a strong solution of hydrochloric acid, it will be found impossible to boil away all, or nearly all the acid gas. If we operate on the acid solution of the specific gravity of 2.21, it will part with gas until it has a density of 1.10 (at 60 deg.), when it will have a boiling point of 232 degrees Fahrenheit, and will distil unchanged. We see, then, that ammoniacal gas and hydrochloric acid gas are greedily absorbed by water; there must be some important difference in the constitution of the respective solutions. We have seen the alkaline solution is much lighter than its own bulk of water; the acid solution much heavier; that the presence of ammoniacal gas in water lowers its boiling point, while the presence of hydrochloric acid in water has a contrary effect. Hence the mode of combination between ammonia and water must be different from that between hydrochloric acid and water. The one must be a case of simple adhesion, the other of true chemical combination as well as

adhesion. Ammonia let out into moist air simply adheres to the moisture, and increases its volume. Vapor of alcohol, ether, etc., does the same. Now any amount of aqueous vapor that the air can maintain in an invisible elastic state, at a given temperature, it can maintain with increased effect in the case of ammonia vapor, alcohol vapor, etc. Hence the combination of these vapors with the moisture of the air is necessarily an invisible compound. Hydrochloric acid gas, on the other hand, let out into the air, combines chemically with the moisture, producing condensation and diminution in bulk. Hence the compound is visible just as the condensation of pure steam in air produces visible vapor. Fuming nitric acid and Nordhausen sulphuric acid are also cases in point. Concentrated nitric acid exposed to the air absorbs moisture until it attains the density of 1.424, when it distils unaltered at a boiling point of 250 degrees.

Dr. L. Feuchtwanger.—The cause of this may lie in the fact, that hydrochloric acid contains but one equivalent of hydrogen, while ammonia contains three equivalents.

Dr. P. H. Vanderweyde.—I think it will be found that the affinity of hydrochloric acid for water is much stronger than that of ammonia for water. When we distil hydrochloric acid gas, we have to be very careful that a drop of water does not get in; for if it did it would absorb all the gas present with such a shock as would almost blow up the apparatus.

Iron Refined without Puddling.

A new process of refining iron by the mechanical admixture of oxyds of iron with the melted crude metal, is now in practical operation at the Schœnberger Juniata Works, in Pittsburg. The melted metal is run direct from the blast furnace into the large kettle having a capacity of five tons; from thence it is poured in a stream into a revolving circular trough about twelve inches wide and ten inches deep, the diameter of the whole being about fourteen feet. As fast as the metal is poured in, the pulverized ore descends from a hopper, thus: As the trough revolves, alternate thin layers of melted metal and raw ore are made which combine in a very satisfactory manner. The machinery used in this operation, is managed by one man. When the trough is full, the metal, before it has cooled, is broken up into slabs of suitable size for the heating furnace. This is said to be the most important improvement in iron making introduced in many years.

Dr. Parmelee.—This is in fact the earliest process known for making iron, the process adopted by the old Hindoos. By this process a pure fine iron is obtained, but the difficulty is that your slag will be so rich in iron that it will pay you to erect a blast furnace by the side of your other works, for you will in fact have an ore-bed of very rich ore on your premises, that ore being the slag which will contain from fifty to sixty per cent of pure iron.

Dr. Feuchtwanger.—I have supplied the parties with large quantities of nitrate of soda and manganese, and they all seem to be very well pleased with it.

Dr. Parmelee.—That they turn out first rate iron, and that they purchase manganese and nitrate of soda in large quantities, I have no doubt; but I very much doubt the statement that they make it pay.

Dr. Vanderweyde illustrated on the black-board the chemical reactions which occurred.

Dr. Parmelee.—That by these means you can get rid of all the uncombined carbon, I have no doubt, but that you can get of the last portion of carbon, that which is *combined* with the iron, I utterly deny. I have seen it tried over and over again, without success.

New Tin Mines.

The great value of the tin workings at Junk, Ceylon, said to be not less than 150,000 tons per annum, have incited a Chinese merchant to propose the development of the tin district at the Isthmus of Kra, in Siam. He is to have the government of the district, to enable him to carry out his designs. As the river Kra is the boundary between British Birmah and Siam, it is probable that the product of these tin mines will be carried to England.

Dr. Feuchtwanger.—The tin mines of Mexico prove to be very rich.

Preparation of Nitrogen.

An Italian chemist, Mr. Massino Levy, has devised an admirable method for preparing nitrogen gas. It consists in heating bichromate of ammonia in a retort, when the salt is transformed into the green sesqui oxyd of chromium; the remaining oxygen, having united with hydrogen of the ammonia, forms water; while the nitrogen of the ammonia, on being isolated, assumes its natural state as a gas. A good deal of random discussion followed the reading of this note, but no very definite conclusion was reached.

New Green Pigment.

Among the substitutes proposed for the dangerous green containing arsenic, is that produced by M. Moulin. He mixes 100 parts of a hot solution of zinc in hydrochloric acid, with from one to fifteen parts of a hot solution of the oxyd of cobalt in hydrochloric acid, the proportion being varied according to the shade of color required. A solution of carbonate of soda is then added to the mixture, when a precipitate of the mixed hydrated carbonates of zinc and cobalt is formed. The chlorine in the first mixture unites with sodium in the carbonate solution, forming common salt, which is removed from the precipitate by washing it with a large quantity of water. The precipitate is then dried on chalk or gypsum plates, and subsequently heated to at least 1,000 deg. C., when it assumes a yellow color, but on cooling it becomes green. By using sulphate of alumina in place of a portion of the zinc in the first mixture, a bluish tinge may be given to the pigment.

Cotton Waste as a Manure.

A French cotton spinner has used his cotton waste, for the last ten years, for seed beds and early crops. He mixes the waste with stable manure, and thus claims to avoid the burning and chills which manure alone often causes. The waste, applied to an asparagus bed in a layer about eight inches thick, was found to protect it from snow, and to so hasten the growth of the plant that tender and well flavored asparagus had been gathered in the midst of winter. It was pretty generally thought that cotton waste is too valuable to be used as manure.

Omnimeter.

This name is given to a new and ingenious instrument designed by M. Eckold. It is used in measuring distances, altitudes and angles. It consists: 1. Of a graduated circle to read off each ten seconds in the measurement of horizontal angles; 2. Of a powerful telescope, revolving in a plane perpendicular to the graduated circle; 3. Of a microscope of high powers, connected with telescope, and moving with it; 4. Of a highly sensitive level lying upon a rule of a fixed length, say twenty centimeters; 5. Of a scale fixed vertically at the extremities of the rule, at a distance coincident with the optical axis of the microscope, which scale is divided into half millimetres, from one to 200; 6. Of a microscopical screw movement con-

nected with the base of the scale, and giving the two ten-thousandths of a millimeter, legible on the graduated scale beneath; and 7. Of an extremely sensitive level capable of being applied to the telescope, and of determining, when required, its horizontal adjustment. The leveling staff used with the omnimeter is not divided, but is of an invariable length, which is defined by two white lines on a black ground, one at the upper end and the other at the lower extremity. The omnimeter is found especially useful in difficult and hilly ground where leveling in the ordinary way becomes a tedious operation, because the sights are short and are multipled in proportion to the rapidity of the incline. With the new instrument the levels may be taken at much greater distances apart, even where considerable angles are made with the horizon. The omnimeter embraces all the advantages of the theodolite and level, and does away with the tedious chain measurements; furthermore, its operation requires no complicated calculations.

Mr. T. D. Stetson.—A cheap and simple instrument for measuring distances is a want that is widely felt. Some years ago a Mr. Crandall, of western New York, invented an instrument for measuring distances, which did the work very well. The principle consisted in taking a fixed base, very short, say one foot, and attaching to each end a telescope, which turned on a pivot, and carried an index moving near a graduated arc. By fixing the instrument, and then directing the telescope to the object, the angles at the base of the triangle thus formed are measured, and the distance easily calculated. But in this case it was not necessary to *calculate* the distance, for instead of having angles marked on the scale the distances themselves were marked off so as to be easily read. This instrument was tried and found to work well for all moderate distances. It was even tried at distances of fifteen miles, and found to give tolerably accurate results. But it fell out of use, and I have not seen one in a long time.

The chairman made a diagram on the board, and explained the principle upon which the instrument described by Mr. Stetson must have worked.

A gentleman present remarked that he had no faith in such instruments applied to the measurement of such great distances. The base is so short that the slightest change produced by heat or moisture will vitiate the result to such an extent as to render them worthless.

Mr. T. D. Stetson.—That brings to my mind the fact that there is a great want in this direction. Now, it has been said that in this

country of ingenious inventors a want properly announced is half supplied. I wish some of our inventors would get up a material which would be unchanged by heat or cold, moisture or dryness. Wood comes nearest to this of anything we know. All other bodies are easily changed in size by the action of heat. I remember the time when Whitworth, who was known at that time more as a manufacturer of fine tools than an inventor of rifles, had one of his micrometers in this city. One part of the instrument consisted of a small piece of steel which passed between two surfaces and indicated the distance between them. When this piece of steel was cool it would drop in very freely, but the merest touch with the fingers would expand it so that it would stick and no longer fall down.

Dr. D. D. Parmelee made a diagram of the well-known walking figures, which are propelled by means of alternate expansion and contraction. He then called Mr. Stetson's attention to it as an evidence that wood is not so unchangeable after all.

Mr. J. K. Fisher.—This subject is of great importance in regard to the scale used by draughtsmen. If the scale expands and contracts we never can make two measurements alike. Wood scales are tolerably constant, but ivory scales, though much finer, are nearly worthless.

Dr. J. W. Richards.—It occurs to me that as wood is changeable chiefly on account of its hygroscopic properties, the best way to get a perfectly unchangeable substance would be to use charcoal. Scales made of charcoal could not alter.

Mr. J. Phin.—Why go to the trouble of getting up a special material for scales, when a scale, no matter how accurately it may be made, nor of what unchangeable material it may be constructed, can be used only to take measurements from the very changeable substance on which the drawing is made, viz., paper? Would not a better way be to lay the scale down on the drawing itself? Then whatever change occurred in the drawing would occur in the scale too, and thus their relative proportions would remain the same.

Mr. J. K. Fisher.—We have all seen these scales. They are used by draughtsmen simply because they are cheap. A paper scale costs a few cents, while a proper scale is quite expensive.

Mr. J. Phin.—I had no intention of alluding to the chart scale mentioned by Mr. Fisher. I referred to accurately constructed scales laid down by the draughtsman himself on the very paper on which the drawing is made, so that whatever changes occur in the one may occur in the other also.

Dr. Vanderweyde.—We all know that paper is very hygrosopic The doctor here made a diagram on the black-board, and observed that paper arranged in this way formed a very good hygrometer.

Dr. Parmelee.—We have all seen collars coated with a paste made of baryta, bleached shellac and some other substances. Such collars resist moisture perfectly. Why should they not resist hygroscopic influences?

Mr. T. D. Stetson suggested that charcoal might be coated with India rubber.

Dr. Parmelee.—Unfortunately India rubber is one of the most hygroscopic substances we have. Of water, it absorbs nearly fifteen per cent of its own weight.

Dr. Vanderweyde.—I would like to call attention to the method devised by Prof. Plattner for procuring blocks of charcoal of any size. He takes fine charcoal powder, mixes it with flour paste and bakes it. It is then charred, and is ready for use. But charcoal itself is probably very liable to change its volume. We know that it absorbs gases very powerfully, and it is probable that it expands in doing so.

Dr. Parmelee.—After all, perhaps we had better leave this subject in the hands of the draughtsmen. Their plan of using paper is probably the best.

Mr. Fisher.—Paper scales are only used on account of their cheapness.

Mr. Phin.—Allow me again to state that I do not refer to scales purchased in the form of small slips of paper. The scale must be laid down on the very paper on which the drawing is made. It will then expand and contract with it.

Dr. Vanderweyde.—It is obvious that as different kinds of paper expand and contract at different rates, the only way to insure accuracy is to use the same paper for both the scale and the drawing.

GALVANIC BATTERIES.

Prof. G. W. Hough in his recent report as director of the Dudley Observatory, at Albany, N. Y., gives the conclusions arrived at after a series of experiments with galvanic batteries as follows: 1. In the sulphate of copper batteries (Daniell's form), the principal cause of the decline in the electric current is due to the formation of the sulphate of zinc. 2. The quantity of electricity flowing in the external circuit, depends on the specific gravity of the sulphate of zinc solution. 3. When the sulphate of zinc solution approaches saturation,

polarization takes place in the battery itself, and, although electric motive force remains the same, the internal resistance may be increased more than a hundred times. 4. The sulphate of zinc solution (or any fluid about the zinc), is useful only as a conductor of electricity. 5. The copper, or negative metals is useful only as a conductor; since it can be replaced by any negative metal, even by zinc itself. 6. The internal resistance of the battery has been separated into two parts, viz.: That due to the porous cell and that due to the liquids employed. The specific resistance of the liquids was found to be thirteen; that for a small clay cell seventeen, and for a leather cell seven; since the resistance of the leather cell is less than one-half that of a clay cell, we have used it in the construction of batteries, as the quantity of electricity is nearly doubled, without any increase of the surface. For the negative metal, in place of the copper heretofore employed, we have used sheet lead. The investigations have enabled us to compute with great precision the length of time a battery will generate its normal quantity of electricity, provided the amount of electricity flowing in the external circuit is known, and the capacity of the vessel holding the sulphate of zinc solution is determined. The specific gravity of the sulphate of zinc solution should not be less than fifteen deg. nor more than thirty deg. Baumé.

Dr. L. Bradley had experimented with solutions of sulphate of zinc of various degrees of density and had not found much difference. There was no difference between a solution showing a density of forty deg. Baumé, and one showing fifteen deg. Baumé.

Mr. J. Phin.—Sheet lead has long been used for the negative metal in sulphate of copper batteries. In the first work ever published on the electrotype, Mr. Spencer described a battery of great power, in which the negative metal consisted of thin tea lead, crimped or corrugated, so that a great surface might be compressed into a small space. The power of the sulphate of copper battery depends largely on the amount of surface presented by the electro negative element, and Mr. Spencer obtained this increased surface in a very simple and cheap manner. In regard to the cells, clay cells vary very much in the facility with which they conduct the electric current. I have tested them with a galvanometer, and have found that some conduct more than twice as readily as others. Leather cells have been tried, but are inferior to good clay cells. Cells made of paper offer the least resistance of any, but they do not last long, and they allow the sulphate of copper to pass through and attack the zinc.

Dr. P. H. Vanderweyde.—I can corroborate what the gentleman has said in regard to the conducting power of clay cells. In some experiments which I made with Mr. Chester, we found that clay cells might conduct electricity too freely and we found an advantage from drawing a line of varnish spirally around the cell, thus diminishing its conducting power.

Adjourned.

April 1, 1869.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

Dr. L. Feuchtwanger exhibited several specimens of sand and sandstones, such as silica, elastic sandstone, Devonian sandstone, rock crystal or Brazillian pebble, quartz from the Pyrenees and the Alps, agates, Arkansas stone or hornstone, onyxes, sea and river sand; also sticks of glass in which several colors were combined, a plate of looking glass silvered with the nitrate of silver, white glass made of cryolite and felspar, sometimes called porcelaine, corundrum, which is next to the diamond in hardness, and used much in rock drilling. The doctor then read the following paper:

Sand, Geologically, Chemically and Technically Considered.

Dr. Lewis Feuchtwanger.—Sand is the term generally applied to all powdered stone, but pure sand consists of particles of quartz, silex or silica, which is composed of silicon and oxygen; and its chemical symbol, under the new atomic weight given to silicon, is $Si. O_2$. These particles, which are more or less rounded, are of a white, gray or grayish red color, and are unquestionably derived originally from a compact rock, called the sandstone formation. Sand may, however, be granitic, containing particles of felspar. This is the case when it has not been exposed to atmospheric agents long enough to decompose it. Sand consisting of angular grains is mostly employed for mortar or building purposes. The rock called sandstone is made up of agglutinated sand or pebbles and fragments of the same. It may be a siliceous, granitic, porphyritic, basaltic or calcareous sandstone, according to the material which occurs with it in nature; and it may be a compact, friable, ferruginous or concretionary sandstone, according to its structure. Again, if the sandstone glistens with scales of mica, it is called a micaceous sandstone; if much clay is mixed with the sand, it is called an argillaceous sandstone; and if this contains

lime, it is called marly sandstone. If the quartz or sand pebbles are rounded, and are held together in a conglomerate, the result is called a pudding-stone; and if they are angular, a breccia.

The flexible sandstone, or itacolumite, is a schistose quartz rock.

Buhrstone is a cellular silicious rock.

The millstone, or gritrock, is composed of siliceous pebbles.

Siliceous schist is a flinty quartz rock.

Jasper rock is likewise a flinty siliceous rock.

Obsidian volcanic glass, or pumicestone, pitchstone, pearlstone, are all siliceous or sandy rocks, having a volcanic origin.

Sand, if transparent, bears the name of quartz, the constituent of a great many rocks, of both the primitive and newer formations. Quartz crystallizes in six sided prisms, with no apparent cleavage, of all degrees of transparency and opacity, and of all colors, from white and yellow green to black, with intermediate amethystine, rose and smoky tints. Pure pellucid quartz is called rock crystal, or pure silica.

Quartz is infusible before the blow-pipe, but when heated with soda, fuses easily to a glass. If quartz has colored bands, it is called agate, and without bands or clouds, it is chalcedony. When massive, of dark and dull color, with translucent edges, it is called flint; if with a splintery fracture, it is hornstone, like the Arkansas whetstone. When it is still more opaque, or black, it is the Lydian stone or basanite; of a dull red, yellow or brown color, and opaque, it is jasper; when in aggregated grains, it is called quartzite, and when in loose, incoherent grains, it is the ordinary sand, which is frequently transparent. Sandstone belongs to all ages, from the lower silurian to the most recent period, but the azoic rocks, which are nearly all crystalline, contain some sandstone; and the metamorphic, which are the most ancient rocks, and comprise granite, gneiss and syenite, consist largely of quartz. Certain dark red sandstone are known as the freestone of New Jersey and Connecticut, and the general term, new red sandstone is applied to this formation, which is more recent than coal, while the old red sandstone lies below the coal, and above the great laurentian formation. Freestone is an excellent building material; in New York it is used more than any other stone. Trinity church, in Broadway, and many other public and private buildings, serve as examples; also the greater part of the flagstones which are brought to this city from Connecticut.

The green sand of New Jersey, which has for the last thirty years

enhanced the agricultural prosperity of the lands of that State, and which belongs to the cretaceous formation, is a sandstone containing iron and potash.

As already stated, sand and quartz are pure silica; still there is no mineral that assumes so many forms and colors as quartz, though none is more easily distinguished. Its characteristic features are:

1. Its hardness, which is from 6.5 to 7, enabling it to scratch glass with facility.

2. Its infusibility; when heated alone before the blow-pipe it does not melt.

3. Its insolubility, as it is not, like limestone, attacked by the strong mineral acids.

4. Its want of cleavage, which has been mentioned above. This is one of the first characteristics of quartz.

5. Its crystalline character, occurring mostly in six-sided prisms, more or less modified and terminated.

6. Its low specific gravity of 2.5 to 2.7, is an unfailing distinctive character of quartz.

Rock crystal is a pure pellucid quartz, and was known by the ancients under the name of *crystallos*, meaning ice. It is used for optical instruments, spectacle glasses, and cut with facets, for jewelry. The crystals are often called real California diamonds. In ancient times it was cut into cups and vases, and it is said that on hearing of his final overthrow, Nero dashed into pieces a cup which was worth $3,000. To this class of quartz belongs the finest ornaments which adorn the palaces of ancient and modern times; and some forms, such as amethyst, rose quartz, *false topaz*, *smoky quartz*, known as Scotch pebbles, or cairngorm, the favorite ornaments of the sportsmen of the Highlands, are used as jewels.

Milky quartz, or greasy quartz.

Prase is of leek green color.

Avanturine, more commonly known as gold-stone, is a quartz spangled throughout with scales of golden yellow mica, although the artificial imitation looks more beautiful than natural stone.

Chalcedony is a translucent variety of quartz, which often lines the cavities of other rocks, and in the form of stalactites, which are then called icicles of chalcedony, and forming grottos several feet in diameter. We find such in the Faroe Islands, in Florida, and in many volcanic rocks, probably owing to silicious waters filtering at

some period through the rock, and deposited by their concentration. Chrysoprase is but an apple green chalcedony.

The *carnelian* is a bright red chalcedony, of a clear, rich, flesh-colored tint; it is a great favorite of the Japanese.

The *sard* is a deep brownish red chalcedony.

Agate is a variegated chalcedony, and its colors are distributed in clouds, spots or consecutive lines, which may be straight, circular or zigzag forms. When the outlines are angular, resembling a fortification, it is called a fortification agate; if dendritic or moss-like delineations, arising from disseminated oxyd of iron, it is called mocha stone or moss agate. The color of agate is much darkened by boiling the stone in oil, and then dropping it into sulphuric acid; a little oil is absorbed by some of the layers and the acid blackens or chars it.

The *onyx* is an agate, where the colors are arranged in flat horizontal layers, formed usually of light clear brown and an opaque white. When this stone is a sard and white chalcedony in alternate layers, it is called sardonyx.

The antique cameos and sculptured small ornaments from onyx are well known, such as the Mantuan vase, at Brunswick, seven inches high and two and one-half inches broad, representing a cream pot, and cut from a single stone; having white and yellow groups of raised figures, representing Ceres and Triptolemus in search of Proserpine.

The cat's eye is a greenish gray translucent chalcedony, having an opalescence or reflection, like the eye of a cat, when cut with a spheroidal surface, probably owing to filaments of asbestos.

The jasper is a dull red silicious rock, containing some clay, and yellow or red oxyd of iron, and has all the varieties of riband, Egyptian resin and porcelain, all assuming a high lustre and polish.

Bloodstone or heliotrope, is of a deep green color, slightly translucent, and containing red spots, resembling red drops of blood; many superstitious people have attached much importance to these red spots, and a bust of Christ in the Paris museum represents quite natural blood drops.

The lydian, or touchstone, is a velvet black, silicious stone, or flinty jasper, which is used on account of its hardness and black color for trying the purity of the precious metals. This is done by comparing the color of the tracing left on it with that of an alloy of known character.

Petrified wood, called also silicified wood, containing the texture of the original wood, which when sawn across and polished is remarkably beautiful.

Quartz crystals are often found inclosed with other minerals, such as rutile, asbestos, actinolite and topaz, oxyd of iron, tourmaline, chlorite and anthracite coal; those containing the rutile look as if needles or fine hairs passed through them in every direction, and when cut for jewelry, pass by the name of love's arrows, or *fleches d'amour*.

The *opal*, one of the most fashionable jewels, is silica, with some water; it exhibits internal reflections of rainbow colors, and forms a gem of rare beauty; it is usually cut with a convex surface. Among the varieties of opal are fire-opal or girasol, it has yellow, bright hyacinth, or fire-red reflections. The common or semi-opal, has a milky opalescence, but does not reflect a play of colors.

Hydrophane, cacholong, hyalite, menilite, wood opal, jasper, silicious sinter, pearl sinter and fabasheer, all belong to the same class of silicious minerals, and are of greater interest to the mineralogist than to the general reader.

Among all the discoveries relating to the arts, none exceed in importance and usefulness to mankind, the art of glass making. Glass is a chemical combination of sand and alkali or alkaline earth, heated to fusion, and presenting after fusion a transparent and hard body. The benefits conferred by it upon all classes of human society have been immense; the spectacle, the microscope, the telescope, and spectroscope, have showered incalculable blessings upon the world, and there are probably still greater discoveries in store for us. The history of the manufacture of glass may be traced from the present time through that of the Romans and Phœnicians, to the Egyptians, some of whose productions remain to this age. The art flourished in Tyre, in Alexandria, and lastly in Rome; and after being depressed for some ages, again revived under the Venetians, who transmitted the improved art to the rest of the nations of Europe. Pliny relates that glass was first discovered by accident in Syria, at the mouth of the river Belus, by certain merchants driven thither by the fortune of the sea and obliged to remain there and dress their victuals by making a fire in the ground. There being great abundance of the herb kali in that vicinity, the ashes of the plant, mixed and incorporated with the sand, formed glass.

Boerham says, that the art of glass making is of ancient origin, being first cultivated in Egypt, while glass was rendered malleable in

the age of Tiberius, and is now manufactured in the greatest perfection. It is one of the most useful arts to mankind; for by it, in conjunction with the grinder's help, we obviate the natural infirmities of the eye. Without it, old people, and those whose optic nerves are affected, would be debarred the knowledge of reading letters or books, and would be unable to sit within doors, or in a coach or ship and see all things clearly around them, yet without being exposed either to the scourging heat or freezing cold, or being annoyed with the east wind, or the ingress of extraneous filth. Pure glass will scarcely receive any stain, and is easily cleansed again. Although the essential constituents of glass are silex and alkali, it generally contains other substances, such as metallic oxydes, which are designed to modify its external character of hardness, fusibility, brilliancy, color and transparency. Many kinds of glass contain either potash or soda; the first is not much employed by the manufacturers of common glass. Some kinds contain lime and oxyd of lead and alumina and oxyd of iron; the two latter are however mere accidental impurities. The following constitute the principal materials of glass:

1. Silex, or sand, which is, as already stated, very abundant on the globe; the sand mostly employed is the white sand, either obtained from the disintegrated sandstone rocks, which are numerous in the United States, as in Missouri, near St. Genevieve, and Berkshire county, Mass.; or from the river sand which is found in large beds of white sand at Maurice river, in New Jersey and Florida. Drift sand is brought by the winds from the sea coasts or deserts, but mostly from the lower sands of sea shores, as we find them for 100 miles on the Long Island shore; this sand when washed forms a good sand for glass.

The infusorial deposits of the silicious shells, called the diatoms, which form immense deposits both inland and on the coasts, yield a good material for the manufacture of glass.

2. Alkali. If potash is used, the purified pearlash is employed, particularly for plate glass and the fewer kinds of crown glass, as also *soda ash*, which is the carbonate of soda, is also used for the better qualities of glass; while sulphate of potash, glauber salt, salt-cake, or common salt are employed for common glass.

3. Lime, either as air-slaked, quick-lime, or as carbonate of lime, such as marble or chalk, is used for the manufacture of green glass.

4. Oxyd of lead, or litharge, or red lead, are usefully employed in the manufacture.

5. Certain materials are used for improving or purifying the glass, such as the binoxyd of manganese, nitre, and arseneous acid, white arsenic. Oxyd of lead, in the form of minium, is principally used in flint glass, as it increases its brilliancy, the purity of its color and the power of its refraction. The binoxyd of manganese, was formerly known as glass-maker's soap ; its effect is ascribed to the facility with which it gives up its oxygen, which combines with the coloring principles and destroys them. In other words, it converts the protoxyd of iron, which would give the glass a dark green color, into a sesquioxyd, which is of higher oxydation and which leaves the glass cleaner.

Borax and boracic acid, as also the borate of lime, called Hayesine, from Peru, are like the Chili saltpeter, very useful and powerful agents for accelerating the fluxing of the silex.

The silex mostly used in England is sea sand, and not river sand, as is extensively used in the United States; it consists chiefly of quartz, and the finest qualities are obtained from Alum Bay, in the Isle of Wight, and from near Lyon, on the coast of Norfolk ; the black flint, when raised to a red heat, and plunged in cold water, is frequently used, and probably gave the name to a species of glass, flint glass or crystal glass.

The color is imparted to glass by the application of the metallic oxyds, and when the coloring is put into the pot so as to pervade the mass, it is termed pot metal, in distinction of such colors as are in the form of enamel or coating on the outside of the various utensils, such as sticks, plates and ornaments.

The *oxyd of cobalt* produces a blue color.

Peroxyd of manganese produces a violet color.

Oxyd of antimony produces a yellow color.

Oxyd of uranium, a canary or opaline greenish color.

Cassius purple, or oxyd of gold, produces a pink, or pink red color, also called the ruby color.

Oxyd of chromium produces green.

Copper protoxyd, produces a dark red or ruby color, while the

Copper oxyd, or black copper, produces a green color.

Silver produces a pure and beautiful yellow, but it can only be produced in the fire of a muffle, and that by staining the surface.

The manufacture of glass is divided into several classes ;

A. Window glass, which includes,

1. Crown glass.

2. Sheet glass.
3. Brown plate, silvered or unsilvered.
4. Colored sheet, pot metal or flashed.

B. Painted and other kinds of ornamental window glass.

C. Cast plate glass.

a. Rough plate.
b. Pressed plate.
c. Rolled plate.

D. Bottle glass.

1. Ordinary bottle glass.
2. Moulded bottle glass.
3. Medicinal bottles.
4. Tubing.

E. Glass for chemical and philosophical purposes, retorts, reservoirs, large water pipes, etc., etc.

F. Flint, or crystal glass, with or without lead; white, colored, ornamented, for table ware, etc.

1. Blown.
2. Moulded and pressed.
3. Cut and engraved.
4. Reticulated and spun with a variety of colors, incrusted, flashed, enameled of all colors, opalescent, imitation of alabaster, gilt, gelatinized, silvered.
5. Glass mosaic, miliflori, and aventurine and Venetian glass weights.
6. Beads, and imitation of pearls, etc.
7. Chandeliers, candlesticks, and lamp apparatus.

G. Optical glass, flint and crown.

1. Rough disks of flint and crown, to make lenses for telescopes, microscopes, stereoscopes, spectroscopes, daguerreotype and calotype apparatus.
2. Flint and crown, blown, or cast in plates for the optician.
3. Fine glass for microscopes.
4. Refractive apparatus, prismatic lenses for lighthouses.

The above classification was made at the London universal exhibition of 1851. Another classification is made in the following kinds, according to their constituent materials:

1. The soluble glass, silicate of soda or potash, or both alkalies combined with silica.
2. Bohemian glass, a silicate of potash and lime.

3. Crown, or spread, a silicate of soda and lime.
4. Plate, a silica of soda and lime cast into plates.
5. Bottle, a silicate of potassa, lime, alumina and oxyd of iron.
6. Crystal, silicate of potash and oxyd of lead.
7. Flint contains more lead than the last.
8. Strass, or paste, contains still more lead than flint.
9. Enameled and colored glass, from all the above except No. 1 and No. 5.

An excess of alkali is often used in order to obtain a more fusible glass, but such glass is more readily acted upon by acids; even when water is boiled in it, it will readily convert red litmus to blue, on account of its alkali; caustic alkali attacks glass by dissolving the silica, and fluohydric acid decomposes glass readily.

As regards the physical characters of glass, it may be remarked that all glass is fusible, but the temperature for different kinds is different; oxyd of lead, or a larger amount of alkaline silicate imparts more ready fusibility, and a similar effect is produced by borax. Bottle glass, containing oxyd of iron and aluminum and less alkali, is more difficult of fusion than other kinds. When melted glass is cooled it is perfectly flexible and plastic before it is cooled down to rigidity; the softer kinds, such as flint or borax glass, when heated, begin to be plastic below a red heat; when in the plastic state pieces will unite together as firmly as if they were melted together. When glass is much softened by heat, it may be readily drawn out into rods or tubes, or, if passed around a revolving wheel, into minute flexible threads, called thin glass hairs, and these properties cause the glass to be formed into numberless shapes demanded by the wants of civilized life.

Glass conducts heat so imperfectly, that the end of a rod heated to whiteness may be held with safety by the hand, within an inch or two of the heated end; the bad conducting power of glass, combined with the cohesive force of its particles, gave rise to the manufacture of Prince Rupert's dross, which are pear-shaped pieces of glass, with a long thin stem, made by dropping melted glass into water; the bulb may be struck without injury, but if the smallest particle of the stem be broken off, the whole drop flies into powder with explosive noise and violence, owing to the bad conducting power of glass, combined with the cohesive force of its particles. Glass expands when heated and contracts on cooling, which must be done very slowly, in order to allow the particles to come uniformly close

together. If suddenly cooled by dropping melted glass into water, the outside suddenly assumes the rigid and more contracted form, while the interior is still soft and expanded from the bad conducting power of the glass. When thoroughly, cooled, the interior must still retain the expanded state, so contrary to its cohesive force at common temperature, and when the cohesion of the outer layer is in the least disturbed, as by a scratch or slight fracture, the whole of the cohesive force exerts its power to fracture the entire mass. From this fact, it is necessary to cool more slowly than can be done in the air and the process of annealing is indispensable. This consists in placing a glass vessel, as soon as made, and while still hot, in one end of a long annealing oven, with a fire at this end and gradually pushing to the further or cold end of the oven; the particles of the interior and exterior have then time to arrange themselves uniformly according to their cohesive force at each point of temperature, until they become perfectly rigid.

Glass is very elastic, as is easily shown by any strip of window glass, but more strikingly by hollow balls suspended by strings. On playing with your fingers on the windows, the harmonious sounds indicate their elasticity. A glass harmonicon consists of small strips of window glass of different sizes, suspended on parallel strings. They may be graduated to any scale; goblets of various sizes are also sometimes employed in a similar manner, and are made to vibrate by passing the moistened finger around their upper edges.

As has been stated, one of the various kinds of glass is the *soluble glass*, or silicate of soda or potassa, or both combined, and on account of an excess of alkali, has become a soluble salt. It is termed also water glass, and has the formula, 2 KO, or Na O3, Si O^3, according to the old notation. The uses of silicate of soda are so well known for the application to wood and textile fabrics, as a paint and substitute of dunging salt in calico printing, that it is unnecessary to devote any space on this occasion.

The *Bohemian glass* is manufactured largely in Bohemia, from 100 parts of silica, purified pearlash, sixty parts, and carbonate of lime, sixteen parts. These three substances are fritted in a reverberatory oven called calcar, and while still red hot, thrown into the glass pots, already in a glowing heat, and there melted, and when perfectly liquid, scooped out or taken out with an iron rod. The objects of fritting are to expel moisture and carbonic acid, and produce a caking of the materials, which facilitates the fusion. This

glass is employed for making panes, tumblers and other articles, which are characterized by their beauty when compared with flint and crystal glass. They also possess greater infusibility and resistance to chemical agents; for this reason it has become celebrated and indispensable in the laboratories.

The *vial and spread glass* has a similar composition to the last described, and contains silica, soda, lime and sometimes potash in similar proportions, as before; but a smaller amount of soda is requisite than of potash, because soda has a lower equivalent. For spread or common window glass, a considerable quantity of soda is used in order to flux the materials rapidly, and the addition of salt is believed to clear the glass.

For making window panes, a lump of melted glass is taken out of the pot, blown and elongated into a pear, then blown and rolled into a cylinder, which is slit longitudinally on one side for its whole length; it is then placed on the smooth hearth of the flattening kiln, with the slit side uppermost, and when softened by heat, is opened, until it spreads out upon the hearth, a flattened sheet.

Crown glass is composed of materials similar to those of the preceding kind, but they are generally poorer; to 100 parts silica, sixty parts soda ash, eight parts potash, ten parts lime, four parts saltpeter or nitrate of soda, one-eighth part of white arsenic is thrown in the melting pot. The mixed materials are placed in a furnace, which is of rectangular construction, containing from four to six clay pots, of the capacity of half a ton of glass, and is now quickly heated up to the melting point. When the first charge is melted down, the next is thrown in, and so on until the pot is sufficiently filled. The temperature is then lowered for a few hours, during which some of the foreign matters subside, and the glass all rises to the top, when, after raising the fire a little, it is skimmed. It is called crown glass on account of the shape it assumes when broken off from the coal formed at the end of the iron rod called the punto.

Plate glass is composed of 100 parts silex, thirty-three parts carbonate of soda, twenty parts carbonate of lime, and a very small proportion of paroxyd of manganese; say one-half part. This glass is usually cast into large plates, for mirrors and large panes; all materials must be very pure. The arrangement for casting the ton of glass into the forms are very interesting, and must be seen personally, at St. Gobin, in France, or at Ravenhead, in England, to be appreciated.

Bottle glass is composed of the coarsest materials of silex, soda, lime oxyd of iron, and clay. It is generally of less specific gravity than any other variety: it is tougher and resists chemical action. In New Jersey, green sand is added to spread glass for beer bottles, etc., etc.

Lead glass comprises three varieties, crystal, fluid glass, and strass, differing in the proportions of litharge and red lead they contain; it may be shown that crystal glass contains but little oxyd of lead, in comparison to the famous paste called strass, which contains more oxyd of lead than silica. The crystal glass is composed of 100 parts of silica, ten parts oxyd of lead, thirty-five parts purified potash, and thirteen parts carbonate of lime. The common flint glass contains 100 parts silica, sixty-six parts oxyd of lead, twenty-six parts purified potash, and seven parts saltpeter. Optical glass contains 100 parts silica, 100 parts oxyd of lead, twenty-three parts purified potash, and a very small proportion of saltpeter and borax. Strass contains 100 parts silica, 133 parts oxyd of lead, and thirteen parts purified potash. The dried and mingled materials are then thrown into the white-hot melting pots, and when full of melted glass, the mouths of the oven are closed. Some heavy combinations of lead sink to the bottom, while the salts, which will not incorporate with the glass, rise to the top as a scum, called *glass gall* and *sandiness.* The greater part of this is skimmed off. Strass is the basis of a beautiful glass, and was invented in the seventeenth century by a man named Strass, of Strasburgh, who first conceived the importance of imitating the real gems as respects their hardness, specific gravity, and refraction of light, and the white mass obtained by his receipt has produced a beautiful base for imitating the diamond, the rock crystal, and the white topaz. It is now manufactured in large quantities in France, as a base also for the production of all other colored gems, such as ruby, emerald, sapphire amethyst, aquamarine, garnet chrysoprose, opal, hyacinth, robellite, indigolite, or blue turmaline, chrysolite, turquoise, lazulite, and agate. Although the properties which are usually considered as constituting excellence in glass for ordinary purposes may be easily obtained, yet in glasses for optical instruments, and to be employed in the examination of objects so remote and so minute as to require the most undeviating accuracy, the difficulty of obtaining the metal (or the mass) sufficiently free from the defects to which glass is incident, has until a late period baffled every attempt to produce a lens, except of comparatively small dimensions; although purity, unchange-

ableness of color, transparency, and a certain degree of refractive power may be obtained, but perfect uniformity in the structure of the glass, so as to render its composition absolutely homogeneous in all its parts, is not so easy to be accomplished, and it is precisely this quality which is the most indispensable in the manufacture of optical glass. The achromatic telescope has been of the utmost importance in the science of astronomy. Galileo, Dolland, D'Artigus, Guinaud, Utzschneider, Bontemps and Ross have all contributed to accomplish the object; and Frauenhofer and Fresnel have carried off the palm in the solution of these great problems. The telescope and microscope of 1869 are proofs of what has been done in this department of applied science.

At the close of the doctor's paper, several inquiries were made by persons in the audience.

Mr. Fisher wished to know Dr. Feuchtwanger's opinion in regard to water in pipe made of coarse bottle glass. The doctor replied that water pipes of this kind had been largely used in England and to a limited extent in this country. Mr. Hamilton E. Towle presented a specimen of what is known as "black diamond," such as are used for drills, for cutting rocks and millstones and wished to know if they were real diamonds or not.

Dr. Feuchtwanger.—I presume they are selected specimens of corundum. I never saw more that two specimens of real black diamond in my life.

Dr. Vanderweyde thought, from a slight examination, that they were true diamonds. There are specimens of diamond which are dark and low-priced, and may be used for drills and picks.

Hill's Air Alarm.

Mr. Hamilton E. Towle presented a model of a Patent Air Alarm, invented by John O. Hill, of New Hampshire, for giving notice of the attack of burglars upon banks, safes, dwellings, &c., and for the purpose of preventing the escape of prisoners from jails and penitentiaries, etc. The principle of the invention consists in using *tubes* either charged with air or exhausted. These tubes are connected with conducting pipes.

Any attack whatever upon the pipe, tending to derange it, communicates to the alarm clock any change in the density of the air enclosed in the pipes. The alarm clock may be situated at any desired point, and every interference with the pipe will cause a

change in the density of the air in the case to which the alarm is attached, and thus set it off.

The tubes are provided inside with small steel rods left free to roll, if an attempt should be made to saw the grating.

The door of a safe may be provided with a conducting tube, the end of which is closed by a valve attached to the door, either *outside* or inside.

Any partial opening of the door allows the air in the tube to start the alarm. Several *alarms* on several doors or gratings may be connected with a single connecting tube, and all the alarms be set in action by any tampering with any part of the arrangement. In the jail at Portland, this invention has been in use two years, and the sheriff and United States marshal pronounce it "the only prison grating in which perfect security is obtained."

RAILWAY ACROSS THE APPENINES.

Mr. J. Johnson exhibited and described a map showing the line of the railway across the Appenines in Italy, extending from Bologna to Florence, and built to establish direct communication between North Italy and Tuscany. This railway is located in the mountainous region along the river Reno, and is remarkable for the engineering difficulties overcome in its construction.

Between Bologna and Pracchia, this latter the most elevated station along the line, and two thousand feet above the level of the sea, the Reno is crossed nineteen times by bridges, and twenty-three tunnels have been dug, having an aggregate length of five miles. Between this point and Florence are not less than fourteen tunnels and many viaducts, and at the Florence end of the road the latter is returned or doubled upon itself three times in order to enable the trains to gradually make the steep incline.

In a distance of fifty miles, there are twenty-three (23) bridges and forty-five tunnels, which vary in length from a few hundred feet to over 9,000 feet. At the point where the railway reaches the plain, it is 2,000 feet above the level of the surrounding country, and descends by a very circuitous zigzag track. Mr. Johnson derived most of his facts from a pamphlet published by Mr. Cook, who in 1858 escorted a party of one hundred persons through most of the remarkable scenery of Europe. As the travelers formed a somewhat numerous party, they were enabled to contract for board-bills, &c., at very reduced rates.

New Dredging Apparatus.

Mr. J. Johnson then exhibited a model of a new apparatus devised by himself for dredging. This dredger consists of an air-tight barge, furnished with a large hole in the bottom, for the purpose of discharging the load; this hole being closed at other times by means of an air-tight cover. The barge is filled by atmospheric pressure applied as follows: From the deck of the barge proceeds a large tube, which descends to the surface of the mud or other matter to be removed. As soon as the barge is exhausted of air, the mud, &c., will be forced up this tube, and will fall to the bottom of the barge. The water is pumped out by the same means that the barge is exhausted of air in the first place, and when a load has been secured, the barge is towed off and emptied.

April 8, 1869.

Professor S. D. Tillman in the chair; Mr. C. E. Emery, Secretary.

Hygrometer.

The discussion of new improvements being announced as in order, Mr. Johnson introduced a very covenient form of hygrometer, with a table of relative temperatures and degrees of humidity attached. The instrument is generally known as the *hygrodeik*, and fully described in the volume of the transactions of the Institute for 1866–7, page 621. A good deal was said about the instrument being self-registering. This, however, is an error, there being no registering apparatus connected with it. The hygrodeik is little else than a mason's hygrometer, the tables which usually accompany the latter instrument being reduced to the form of a diagram, on which a pointer indicates the results. From the pamphlet which was presented by Mr. Johnson, we clip the following: Edson's hygodeik indicates the state of the atmosphere in relation—

1st. To its actual temperature as indicated by the ordinary thermometer (or the dry bulb thermometer of this instrument).

2d. Sensible temperature, or the temperature due to evaporation (indicated by the wet bulb thermometer of this instrument).

The fact that the temperature due to evaporation is often quite different (sometimes amounting to fifteen degrees) from the temperature as indicated by the thermometer, is one of very great importance, and one that is very commonly overlooked.

When we cover a thermometer bulb with a thin piece of cloth, and wet that cloth, we have an instrument which is sensible to the temperature of the air in precisely the same degree that our lungs are; that is, a person may feel too warm, or too cold, in a room the temperature of which (as indicated by the common thermometer) is seventy degrees; for the same reason that, in such a room, the wet bulb thermometer may indicate a temperature of seventy degrees, or of only fifty-five degrees; the first of which, seventy degrees, is too warm, while the latter, fifty-five degress, is much too cold.

The amount of difference between the dry and wet bulb thermometers depends directly upon the amount of moisture in the air. If the air contains all the moisture that it is capable of holding, as often occurs in wash and bathing rooms, it will be found that there is no difference in the readings of the two thermometers; but if the air is very dry, as we often find it to be in artificially warmed apartments, the readings of the two thermometers may be very different.

3d. The relative amount of moisture in the air.

Air absorbs and holds in suspension watery vapor in the same manner that a sponge will hold water; but the amount that a given bulk of air will hold depends upon its temperature. Thus one cubic foot of air, at thirty-two degrees, will hold in suspension but two grains of water, while one cubic foot of air, at sixty-eight degrees, will hold seven and one-half grains. When air, at thirty-two degrees, has two grains of watery vapor in it, it is said to be saturated. When air is saturated, that is, contains all the moisture that it is capable of holding, we say that its relative humidity is 100; if it contains three-fourths of the amount it is capable of holding, we say that its relative humidity is seventy-five per cent; or if one-half, fifty per cent, etc.

We see from this that the relative humidity of the air does not express at all the absolute amount of watery vapor present. For instance, the relative humidity of air at zero may be, say, ninety per cent, and yet contain less watery vapor than air at seventy degrees, whose relative humidity is but thirty per cent.

4th. The dew-point.

A glass tumbler, filled with cold water in summer, is soon bedewed with moisture, not, as is frequently imagined, because the water oozes through the tumbler, but because the air around it is cooled, and its moisture precipitated upon it. The same would occur in winter if the tumbler were brought into a close room in which many persons were assembled, and the air loaded with the accumulated vapor

exhaled from their lungs and skin. From the same cause the cold windows of a crowded lecture room, are constantly covered with minute drops of water, which soon collect together and run down the glass in streams.

The highest point of the thermometer at which vapor begins to be deposited by the air, is called the *dew-point;* it is the point at which dew begins to form.

5th. The absolute amount expressed in grains of water contained in a cubic foot of air, at the temperature, and relative humidity, as shown by the instrument.

6th. The depth in inches of water that would be deposited upon the earth by the condensation of all the vapor held in the atmosphere.

A discussion of the subject followed the reading of the paper, during which several kinds of hygrometers were described, and the imperfection of all commented upon. It was remarked during the discussion that the hygrometer and barometer, taken conjointly, would constitute pretty safe means of foretelling the weather.

The imperfections of barometers were also discussed, Dr. Bradley asserting that the aneroid barometer at great heights was unreliable, no two of them agreeing.

Mr. Stetson remarked that a barometer which would record the condition of the atmosphere at different times during the day, in such a manner that easy reference could be made thereto at any subsequent time of the day, is a great desideratum, and then he asked if there was any self-registering hygrometer now in use.

Dr. Tillman replied in the affirmative.

Mr. Emery remarked that Edson's instrument is certainly very ingenious as regards its mechanical arrangement. He then made a diagram of Prof. Hough's self-registering barometer.

Dr. Tillman.—Hough's barometer records the changes and prints them. A full description was published in the last volume of the Transactions of the American Institute for 1865–6, pp. 460, 473.

Dr. Bradley referred to the aneroid barometer, and stated that it could not be depended upon at great elevations.

Mr. Johnson thinks that the barometer and hygrometer should be used together. To this proposition there was a pretty general agreement.

Dr. Edwards referred to the use made of the barometer by seamen for the purpose of foretelling storms: The British admiralty cause

signals to be transmitted all round the coast of England so as to forewarn seamen of the approach of a storm.

Dr. Tillman.—The admiralty forecasts of the weather have been found to be so generally incorrect that they have been given up. A very good hygrometer for rough purposes may be made of human hair, whalebone, rye straw, etc.

Mr. Stetson inquired about the camphor storm-gauge. It was generally agreed that it was worth nothing. It indicates changes of temperature alone.

Mr. Blanchard described a hygrometer made of a tendril of some plant.

Dr. Smith referred to the use of a live tree toad as a storm-gauge.

Dr. Feuchtwanger.—There is a small ladder placed in the jar with the toad. During dry weather the toad descends into the water, but climbs up the ladder on the approach of rain.

The following interesting notes on scientific progress were presented by the chairman:

A Copying Process.

Niepce St. Victor gives a new process for copying very old writings. Ordinary copying paper is used, but is moistened with a thin solution of glucose or honey, instead of water. On coming out of the press, the paper is exposed to strong ammonia, which brings out very clearly lines otherwise almost illegible.

New Optical Glass.

Messrs. Chance, of London, who have acquired the reputation of making the best glass in the world for optical instruments, are now engaged in manufacturing an entirely new glass for photographic cameras, which is said to have, what many will be inclined to doubt, a density of 4.4. Its composition has not yet been given to the public.

Sea-Weed Charcoal.

The London *Chemical News* states that this material, which is prepared from the fine tangle of the Hebrides, is being extensively used in England as a substitute for animal charcoal as a filtering medium for water, for deodorizing sewage, clearing white glass, removing acidity from and decolorizing wines, and precipitating and decolorizing vegetable alkaloids.

Solar Gaseous Spectrum.

Mr. Norman Lockyer first proposed a plan for detecting the gaseous spectrum of the sun, without the intervention of an opaque body, as in the case of an eclipse, to cut off a direct light, but Mr. Gansen, of France, was the first to obtain such spectrum under the direct light of the sun. Mr. Lockyer, two months later, did the same thing, and found a gaseous spectrum of a certain height, present at all points, and hence concludes that an envelop of luminous gas surrounds the sun, to a distance of about 5,000 miles, while the luminous prominences are only accumulations of the same gaseous matter, reaching sometimes to the height of 70,000 miles.

The Ophthalmos.

This instrument, invented by the Rev. John A. Scott, of Morefield, West Virginia, is an automatic photographic camera, which is elevated by means of a small balloon, and held at the required height by a cord, until a picture of the landscape below is taken. The camera hangs in a vertical position, and contains a sensitized plate, which, after having its focus adjusted, is elevated and exposed by means of clock-work, so arranged as to operate precisely at the moment when required, when the plate is again covered by an automatic action and the balloon is drawn down. Within the camera is a magnetic needle, which is arrested, on a graduated circle, by means of a wire net-work, at the instant the plate is exposed, and thus is indicated the magnetic meridian of the place represented in the picture. The truthfulness and minuteness of detail thus obtained, makes this ingenious photographic arrangement preferable to the old photographical method, which, from the time and labor required for actual surveys, is by far the most costly.

Wire Tramways.

At Bardon Hill Quarries, near Leicester, England, a new kind of tramway is in successful operation. It is about three miles in length and consists of an endless line of wire rope, which is elevated and passes over one set of rollers, each roller being sustained by a pole, and returns by another set of rollers and poles. At one end the wire passes over a clipped drum, which is moved by a steam engine. Boxes in which goods are to be carried, are suspended from the rope, and so arranged with suitable grooves in the hooks by which the boxes are held, that the latter are prevented from coming in contact

with the poles which sustain the wire. No grading being required in this plan, it is claimed to be economical in passing over very uneven ground. Such tramways, suitable for transporting fifty to one hundred tons per day, supplied with the regular steam engine and rolling stock, can be constructed in England at from $1,000 to $5,000 per mile.

THE EARLIEST PLANT.

Since the discovery of Eozoon in the Laurentine rocks of Canada, the earliest animal organism known to have existed on our planet, no geological observation has excited greater interest that the recent detection of what appears to be the remains of a terrestial flora in certain Swedish rocks of the Lower Cambrian age. These fossil plants seem to be allied to the grasses and rushes of the present day. They have been provisionally included in one species, under the name of *Eophyton Linnœanum.* According to our present paleontological knowledge, in point of antiquity the Eophyton holds the same position in the flora that the Eozoon does in the fauna.

MACHINE FOR PLASTERING.

Mr. John Aspden, of Orange, New Jersey, exhibited a model of his apparatus for plastering walls, ceilings etc. It consists of scaffolding, so built as to be capable of being widened or of being increased in height according to the size of the room, and containing a box at the top holding the mortar. The frame or scaffolding runs upon rails laid upon the floor. In moving it causes, by a rope connection, the box containing the mortar, to move on rails laid on the top of the frame. This box contains a false bottom, which advances outwardly as the box moves along and pushes the mortar against the wall. The mortar box is provided with a trowel. The machine is constructed to plaster ceilings or side walls. Several objections were urged against this machine, but were all answered by the inventor.

Mr. Dudley Blanchard said: That first, the peculiar knack of spreading mortar on laths, requires skillful operation; and second, there is not one ceiling in a thousand that is parallel with the floor, and therefore this apparatus seems to be an impracticable machine. It appears to answer for so small a number of places, that it would hardly pay, even if done as well as by hand.

Mr. C. E. Emery stated that after examining the model, he thought a perfect plastering machine can be made. A little exertion in this

direction would soon accomplish the desired end. The defects of this apparatus would show where the improvements are to be made. He commended this apparatus as ingenious, and hoped the inventor would perfect it.

Dr. J. J. Edwards thought that at the present high rates of labor on indoor work, almost any machine would pay if it could be made to operate satisfactorily.

Adjourned.

April 15, 1869.

Dr. D. D. Parmelee, in the chair; Mr. C. E. Emery, Secretary.

Dr. Parmelee stated that Professor Tillman was detained at Albany on business connected with the Institute, and, at his request, he, the doctor, occupied the chair. He would open the proceedings by requesting an exhibition of new inventions.

Ventilator and Air Filter.

Mr. Converse exhibited a model of the ventilator invented by Mr. Lesperance, of Canada, which is intended to be used for filtering the air which is admitted to buildings, railroad cars and passenger vessels. The air is caused to pass through three plates of perforated tin, a covering of sponge and a box filled with charcoal, and the inventor claims that any superfluous dampness will be retained in the sponge, in the first chamber, while all impure gases will be absorbed by the charcoal in the second chamber. "The air is rendered warm, first, by the amount of friction it has to undergo; secondly, by being deprived of its watery vapor, and thirdly, by the chambers through which it passes being warmed by the heat of the room."

The reader will understand that this description is taken from the pamphlet published by the inventor.

Dr. Bradley asked what power was employed for the purpose of forcing the air into the room, and also inquired what number of ventilators would be required for an ordinary sized apartment. The reply was, that one ventilator of ordinary size would provide an amount of air sufficient for twelve persons.

The exhibitor explained that the ventilator was not intended to provide for the exit of the foul air; that it was to be supposed that

avenues for the exit of this air already existed or could be easily made.

Mr. Phin.—I understand you to say, that the sponge is for the purpose of absorbing the moisture of the atmosphere. (The exhibitor confirmed the accuracy of this impression.) Now do you not think that something that would moisten the air would be more valuable than anything that will dry it? I deny entirely that the sponge will have the effect that you say it will have; but if it did produce the effect described, I think it would be a disadvantage, as in nine cases out of ten the air in our houses is too dry.

Dr. Allen.—The object of this ventilator is to purify the air from those miasmic influences which are so prevalent. The charcoal frees the air from all miasmatic germs, and from all organic impurities, and thus prevents the spread of fever and ague and numerous other diseases. All scientific men agree that charcoal is one of the best purifiers, and in this case we have applied it to that article of which we consume most, viz: The air we breathe.

Dr. Edwards.—It seems to me that this ventilator is a one-sided affair. You might just as well set a one-legged man to run a race. The air cannot enter freely through all this mass of sponge and charcoal; and what we want is abundance of air. Plenty of air, even though the air be poor, is better than no air at all. What consumptives want is air. The old hot-house system of treating patients has been entirely abandoned by the best physicians, and now we send them to St. Paul, Minnesota, where the air is clear, cool and bracing. As a part of a system of ventilation, this ventilator is all very well; but as a system of ventilation it is defective.

Dr. Allen.—Consumptives want air, but they want pure air.

Dr. Edwards.—Better breathe bad air than none at all.

Mr. Fisher.—Let us have the air as God gave it to us. During my time I have seen a great many attempts at purifying the air in railroad cars, and I have been consulted professionally in regard to them a great many times, and I have often been astonished at the amount of dust and dirt which these purifiers would extract from foul air. But after a little, that is, just as soon as the excitement died out a little, the railroad companies have abandoned them, and things go on just as they did before. If we could only get the air as God gave it to us, we would do well enough, but unfortunately we have very little such air in New York.

Mr. J. A. Whitney remarked that ventilation is required most where foul air abounds. In the country districts where the air is

pure there is perhaps not much necessity of it, but in cities and on the banks of streams where there are very deleterious matters, this system of ventilation would be very requisite.

PLATING STEEL WITH NICKEL.

Mr. Smith, of Boston, made some remarks on the process of Dr. Isaac Adams, Jr., for coating steel with nickel. He exhibited several pieces of cutlery plated with that metal. The advantages, he said, which are claimed for this process are, in the first place the nickel is cheaper, as it can be procured for three or four dollars a pound. And in the second place it is less liable to tarnish from exposure to the atmosphere than silver, and if subject to wear, is much harder and more durable than it, while the color is much the same as that metal. Some fifteen or twenty years ago, Smee, in England, described this process, and even men in this country have done it. The coating of cutlery is now, however, done with nickel very beautifully in Boston. But Dr. Adams has gone beyond what has been done heretofore. Formerly only a thin film of nickel could be deposited. Nothing like depositing nickel in the reguline state, as it is called, has been done previous to Dr. Adams. The specimens here shown are evidences of the perfection to which it is brought. In the coating of polished sheet iron, Dr. Adams has done remarkably well. He was sorry he had not some specimens of this kind with him. Some that he had in Boston were one-eighth of an inch thick. Dr. Adams has perfected the process so far as to be able to plate cutlery with nickel with the same facility as copper is deposited. The nickel is so hard that it is found as hard to scratch it as the steel. It is a chemical deposition and therefore does not injure the temper of the steel. It is deposited by the ordinary Smee battery, single cell. Copper is very easily deposited in the reguline state; a pure deposit of copper can be obtained within a very wide limit, while some of the other metals can be done so in a very narrow limit, depending on the intensity of the current and the strength of the solution. It is a scientific question of deep importance to know what causes this. He believed that this process of depositing nickel will throw much light on the process of electro deposition of other metals. He had in Boston some specimens covered with cobalt. These perhaps were the first specimens that have been obtained. The color Dr. Adams says is better than nickel. With the improvements of Dr. Adams he thought iridium could be deposited by electricity. By the deposition of copper it is

well known plates are made for engraving, but the difficulty is that plates of deposited copper are very soft. Now, there is no reason why duplicates cannot be made of nickel which will wear as long as steel, and be much less liable to injury, and free from corrosion. He was sorry he could not state the means by which Dr. Adams obtains these results, as his memory was not sufficient to carry all the details of his process. All that he could say was that the process was exceedingly simple, the preparation of the solution can be made in various ways. The process is not patented yet. He believed it was the sulphate or the chloride of nickel which was used in the solution. He had seen specimens of knives plated with nickel which had been in use about three months and they appeared the same as silver knives would be worn. The ordinary silvering of knives is very thin, and lasts only a short time. For the same thickness nickel would last much longer, and not be liable to corrosion. It has been assumed that in order to deposit nickel, a very pure solution must be had, but this is not so; the specimens shown here were plated with nickel, not over seventy-five per cent of nickel, and the deposition was thrown down at some ninety per cent.

Dr. L. Bradley remarked that the nickel on the knife shown exhibited a tendency to peal off.

Mr. Smith said that was on account of the knife not being cleaned before plating; silver would do the same. If properly cleaned, the nickel would adhere the same as any other metal. Copper can be deposited better than any other metal. Nickel stands in the same relation to plating that silver does to copper in the electro-plating process.

Dr. Isaac Adams' address is No. 8, Boylston street, Boston. He was the first to deposit nickel on plates that could be used in the first process. Nickel, we know, is much cheaper than silver, and the deposition of it costs about the same as silver.

Artificial Stone.

Mr. Thomas Hodgeson, No. 7, Beach place, Brooklyn, exhibited his process for making artificial stone. He had four patents for making artificial stone of various kinds. He used the oxalate of lime, mixed with sulphuric acid and sand. These he placed in a mould without any lubrication, and in a few minutes it was taken out ready to be dried; after which it is placed in a solution of oxalic acid, and there it indurates. He had exposed this stone to all varieties of weather, without being the least affected by it.

Mr. T. D. Stetson inquired if large masses of this stone could be made as well as the specimens.

Mr. Hodgeson replied that large masses could be made equally as well. If the stone is exposed to a dull red heat it improves it.

Mr. Stetson wanted to know how long it is requisite to keep the stone in the oxalic acid bath.

Mr. Hodgeson said the time varied, according to size, from two to four hours.

Mr. J. Johnson inquired how much acid a cubic foot of the stone would absorb.

Mr. Hodgeson said he had not experimented on a scale large enough to answer that question. The oxalic acid in a weak solution, four ounces to a gallon of water; the proportion of moistened lime is from three to four, according to the quality of the sand; slightly slaked quicklime is used.

Mr. D. Blanchard inquired at what price this stone could be made for decorative purposes?

Mr. Hodgeson replied that they could be made at a fraction over the price of ordinary architectural ornaments, say some fifteen per cent.

Dr. P. H. Vanderweyde said it was a happy idea to employ the oxalate of lime in this process. Now, in order to make the lime insoluble, oxalic acid is put in it. The principle is simple. The lime in the sand has great affinity for the oxalic acid with which it combines and becomes the oxalate of lime, which is insoluble in water. In regard to the amount of oxalic acid absorbed, all that is required is to make the combination complete.

A New Motor.

Mr. John Johnson exhibited a model of a motor, which was placed in a glass vessel in which water is boiling. The flame of gas being placed to one side of the vessel, an upward current of steam is generated on one side, which acts on the paddles of a wheel wholly immersed in the water, causing the wheel to revolve quite regularly. It might, he said, be called a household motor. The velocity of the paddles are due to the amount of water evaporated. It performs as well as any rotary engine.

The chairman next called upon Mr. Frank Dibbin, a former member of the Polytechnic, whom he noticed to be present, and who had just returned from Colorado, to make some remarks:

Mr. Dibbin said the mining interests of our western country is now in much better shape than formerly. They have unfortunately been neglected till within a few years, and now the people of that country are not so anxious to have settlers come there. The mining resources of both Colorado and Nevada, are being developed to a large extent. Nearly every season we have new discoveries, some of them, no doubt, exaggerated, but still showing wonderful progress and activity of the people there. Sometimes curious formations of veins in the mountains of the Sierra Nevada are met with, the causes of which are somewhat obscure. In the same geological formation which on this island has an angle of forty-five degrees, there the same rocks are in a vertical line, and across this strata are deposits of valuable metals, such as copper and gold, usually found as sulphides. (Mr. Dibbins here made a diagram, on the black-board, showing the formations of the veins, and the point at which the sulphides are deposited.) The climate is not cold, yet is much milder than here; and we have the phenomena of having frozen snow and ice at a depth of 1,100 feet. The same causes that lets the snow remain during the winter, prevents its thawing in the summer. Every season it freezes a little deeper, and in time ice of immense thickness will be formed. All this is caused by the peculiar shape of the mountains which prevent the rays of the sun from melting the ice; the temperature there is about fifty degrees. One hygrometric peculiarity is that the air is very dry. In this city if the temperature is at fifty degrees, it will feel cold, but there, having no moisture in the air, it feels quite warm, so that out-door work can be done without having coats on. In the month of August, heavy rain storms occur, yet, in three hours after it has ceased, the ground is thoroughly dry. On these mountains we can see the beautiful phenomena of hail forming out of the heavy moisture, and see the sun shining at the same time. It is probably the healthiest climate in the world; it is very free from the variations which we have here. The only time we catch cold is when there is a continuous storm. He lived mainly out of doors during the four years he was there, In the neighborhood of Georgetown, out of a population of 4,000. there were only three deaths. A most magnificent spectacle can be witnessed from the peaks of the Rocky mountains; the vast plains; the mountains winding on each other; the ridges seeming to be covered with snow, but it is only the superior reflection of the light; then the South Pass, which is a misnomer, for it should be called the

North Pass. These and many other sublime sights can be seen from these lofty elevations.

Adjourned.

April 22d, 1869.

Professor S. D. Tillman in the chair. Mr. C. E. Emery, Secretary.

The chairman opened the proceedings by reading the following notes on new inventions and discoveries:

Cement for Bottles Containing Volatile Liquids.

Chemists who have used a luting of melted sulphur for sealing bottles containing ether, benzole, bisulphide of carbon, and other volatile liquids will find it much more convenient and quite as effective to mix finely ground litharge and concentrated glycerine and apply the mixture as they would paint around the cork or stopper. The coating soon becomes extremely hard and air-proof, but it can be easily removed with a knife.

A New White Paint.

At a recent meeting of the French Academy of Sciences, M. Sace called attention to the fact that tungstate of baryta forms an excellent white paint which has as good a tone and depth as white lead, and has the advantage of not becoming blackened by exposure to the atmosphere. Sulphate of baryta or heavy spar has of late been used to adulterate white lead. Tungsten or wolfram is a metal often found with tin, and its production is cheaper now than formerly.

The Yak.

This animal, of the bovine family, inhabiting Thibet, has been subjected to a series of experiments in France for the purpose of ascertaining whether its propagation can be made profitable. Some years since, the French consul-general of Shanghai brought home a herd of yaks, which were placed under the charge of the Societè d'Acclimation, which at its last sitting offered several prizes for rearing and training this animal. The yak combines some of the characteristics of several domestic animals. It resembles the ox, but has a bushy tail like the horse; its hair curls like some kinds of wool, and it indulges in a peculiar grunt, which might easily be mistaken for that of a pig. The wandering tribes of Tartars hold the yak of

high value, because it is a sure-footed beast of burden, and the female yields a rich milk, the butter from which has become quite an article of merchandise. The hair is made into ropes and cloth, and its skin is converted into clothing. The bushy tail is extensively used in India as a brush. Its horns curve outward from the occipital ridge, and are sometimes as white as ivory. The meat of the yak has a flavor somewhat resembling that of venison, which is not diminished by domestication and acclimatization. The wild yak of Thibet is found near the snow line of the mountains, and it is not improbable that this animal would be found of great use if introduced into the mountain regions of the western part of the United States. The domestic animal is generally about four feet high and seven feet long.

Carbolic Acid as a Therapeutic Agent.

Joseph Hirsh, in a paper recently read before the Chicago College of Pharmacy, gives an account of a series of experiments made by him, showing the power of carbolic acid to coagulate albumen, and adds some remarks upon the effect of this acid on the human system, the importance of which can hardly be over estimated. The application of a concentrated solution of the acid to the skin produced in a short time a white opaque spot of horny aspect, which soon peeled off. The same spot, produced on highly sensitive part of the epidermis, as on the tongue, at once loses its sensitiveness, and a feeling as of the presence of a foreign body as a coating is experienced. In both cases the opacity of the spot, by its resemblance to the opaque coagulated albumen, at once reveals the nature of the change produced by the acid. The albumen of the blood, which, through the numberless ramifications of the blood-vessels, is carried to the skin for its nourishment, becomes coagulated. In this state it is solid, precluding the motion of liquids of its own kind within its substance, and with this motion, nourishment and life. As lifeless, dead matter, the skin must necessarily peel off; it must, with the loss of vitality, be deprived of all prerogatives of life and feeling, as noticed above. Taking the coagulation of albumen as the immediate effect of applying carbolic acid to any organic substance, we shall find no difficulty in explaining the suspension of life without its complete extinction in the microscopical beings known as contagion.

They contain, no matter whether they are animalculæ or minute plants (a question not definitely settled), albumen; blood albumen

in the former case, and vegetable in the second. Here the carbolic acid coagulating the albumen on the surface of the corpuscle, forms an insoluble envelop impenetrable to air, and to further quantities of carbolic acid, which in this manner forms an obstacle to the entrance of itself into the interior of the body. This retains in its center a minute portion unchanged, full of life, capable of increase under favorable circumstances, and protected from external influences by its coating of coagulated albumen. Such a corpuscle acted on by carbolic acid, may be represented by an egg exposed to boiling water for a few seconds. The coagulating influence of heat affects the superficial layer of albumen, which still incloses the rest of the egg in its raw state All substances or processes producing the same coagulating effect upon albumen do in reality exert the same destructive influence upon contagion and miasma, but do not possess those necessary properties which qualifies them for this purpose as well as carbolic acid. Heat, which coagulates albumen, has been used successfully in the disinfection of clothing and places infested with the poison of cholera, yellow fever, &c.; but while we can turn high pressure or even superheated steam into a room, a ship, &c., we cannot subject a cholera patient, or an animal infected with the cattle plague, to so high a temperature as to destroy the poison lurking within them; and if in diluted carbolic acid we have a remedy which, with such coagulation, will destroy the activity of the contagion without interfering with the process of life in the patient, we have found a desideratum which is at once a boon to mankind and a victory of science important beyond comparison. The use of other chemicals as the mineral acids, and their salts, which coagulate albumen, is precluded in contagious diseases, under the same circumstances, and for similar reasons, under which superheated steam is unavailable. On the other hand, carbonic acid greatly diluted exerts a barely perceptible influence upon the vital processes of the largest animals, while its powers of destroying sporules is almost equal to that of the concentrated acid. This apparent anomaly is easily explained on comparing its action to the parallel coagulation of a highly diluted solution of albumen by one similarly diluted of the acid. The diluted solution is as completely coagulated as a dense one; but the dilution of the liquid places the particles of albumen at such great distances from each other that they can no longer form a coherent mass after coagulation, but remain separately suspended in the liquid, rendering it opaque and milky in appearance. This liquid, although charged

with insoluble albumen, will filter through paper, as also through the pores of all tissues of the animal organism. The dilute carbolic acid, introduced into the system will, in the same manner, coagulate the albumen and sporules it meets on its passage, in such subdivision that the coagulum can no longer form a dense coherent coating, as in the case during the application of the concentrated acid, while the minute particles of this coagulum, after filtering through the animal tissue, do not oppose an obstacle in the free passage of greater quantities of the carbolic acids or of the vital fluids. On the other hand, the sporules constituting the contagion are so minute themselves that the limited sphere of action of the diluted acid still embraces a complete sporule, or a number of them, which thus have their vitality suspended as completely as by the concentrated acid. This great divisibility (irrespective of the volubility of the acid) prevents its entire neutralization by the albumen of the larger organism to the exclusion of that of the sporules, the albumen being a base of no great energy, especially if linked to an acid as faint as carbolic. Nevertheless for complete curative affect the dose must be repeated, as the acid owns, in common with all other drugs, the property that the limit of its sphere of action is proportionate to its amount.

NEW LIFE PRESERVER.

Mr. James Weston exhibited several ingenious applications of wood cut into veneer. Amongst the rest was a life preserver which consisted of eight hollow cylinders formed of three layers of veneer cemented together, the grain of the wood in the middle layer being arranged at right angles to the grain of the other layers. Each cylinder is covered with a thin sheet of gutta percha which makes them absolutely water proof. Four of these cylinders are inclosed in a canvass case, and two cases are so united by strips that a set of four cylinders may be worn in front of the chest, while the other set of four lie on the back. Each cylinder is about six inches long by two and three-quarter inches in diameter, thus containing about thirty-four and one-half cubic inches, or about one-sixth of a cubic foot for the eight cylinders. As the weight was stated by the inventor to be about one and three-quarter pounds, the buoyant power of the life preserver is equal to about eight and one-half pounds—an amount amply sufficient to keep the face well out of the water if the wearer assumes a proper position. These life preservers can be made for about six or seven dollars; and the great advantage of this life preserver over those made of

rubber is that it cannot by any possibility be punctured with a pin, or by coming in contact with rock or any sharp substance, so liable to be met with in escaping from a wreck or in landing. If one should be punctured, there are seven more left. It can also be very cheaply made, and takes up less room than cork, and will last a hundred years. The same method of construction may be applied to tools, chairs, settees and life boats, so as to increase their bouyancy.

VENEER HUBS FOR WHEELS.

One other application was the formation of veneer hubs for wheels. Mr. Weston stated that a well-known carriage house in this city would test the hubs on a carriage this summer. There was also exhibited a model of a railroad car wheel made from veneer one-eighth of an inch thick; the grain of the wood in each alternate layer running crosswise to the preceding one. The layers are arranged from the outside toward the center, each layer being cemented to the preceding one, and the whole being formed into a solid and very compact mass by the pressure produced by forcibly driving a plug into the central hole. The rim of the car wheel might be either steel or iron; thus would be obtained, what has long been a desideratum, a noiseless wheel for the sleeping cars of our railroads. Mr. Weston stated that he believed it would last longer and answer the purpose better than any other car wheel ever made. It was not claimed that this crossing of the grain of the wood was a new thing. The veneers need not be more than one-eighth of an inch thick, and it will be readily seen that a wheel may be made of any size in this manner.

Mr. Weston said he had made a veneer hat for himself, and also stated that he believed a balloon would yet be constructed of veneer, combining lightness, strength and durability. The latter statement, however, may be regarded as exceedingly questionable.

Mr. Blanchard remarked that this plan of construction is of great value where great strength is required in ornamental work. Arches or moldings of an ornamental character may be made by placing together three layers of veneer, the grain of the middle layer running in a direction perpendicular to the grain of the other two. Draughting boards of the best kind may be made in this manner.

THE BEES AND THE WEATHER.

Dr. Lambert addressed the Association upon a subject to which he had given great attention, namely: The possibility of predicting the

character of an approaching winter from the labors of the bees during the preceding season. He held it to be a fallacy that the winter must be very cold when cabbages were scarce in the summer; and he who judges of the weather by the fullness of the moon is a fool. But the rigor of the approaching winter may be estimated by the amount of honey stored by the bees during their working season. If they lay up a large store of honey, an open winter is sure to follow. If the honey crop is small, the winter will be cold. Last year the bees had garnered less honey than during any season for twenty-three years, and the winter, from the middle of November to the middle of April, was unusually severe. The average temperature was several degrees lower than had been known for more than twenty years (except in five winters), and as he had watched the industrious insects during all that time, and had rarely known the sign to fail, he considered the bee as good an indicator as the southward-flying goose, the river-swimming squirrel, or any other of the thousand living things whose movements, according to the weather-wise, foretell the state of the coming season. In December last he had predicted an early closing of the Hudson; but the navigators of that river, taking their cue from the moon, refused to respect his judgment. He had been watching the bees. On the 11th of that month the ice was sixteen inches thick in the stream, and it cost the owners of one steamer $3,000 to cut her way through to Albany. This result did not follow because nature cared anything about the bees, but because the same causes which cut short the honey crop during the summer conspired to produce a cold winter. The same thing occurs in the case of the currant. If the currant blossoms drop, the summer will be cool and damp. Acid fruits are good when the weather is dry and warm, and it is so arranged that when the summer is to be damp and cool, such fruits shall be scarce. Not because nature cares particularly about our wants and comforts, but because the same causes conspire to produce these different effects.

Mr. J. Phin.—I have given some attention to bees. Last year, in certain parts of the country, the bees stored very large quantities of honey, and in these regions the winter was similar in character to the winter as it existed elsewhere. By what rule would the inhabitants of these districts prophecy the character of the approaching winter?

Dr. Lambert.—These were exceptional regions. I speak of this indication merely as a general rule. During last winter honey was

very scarce and dear. That is the test. Washington market is the best barometer.

Mr. Phin.—Perhaps so, but I think you will find the exceptions pretty general too. Moreover, how would it be if the farmers throughout the country were to take to the general production of some honey producing plant, such as buckwheat?

Minerals.

Dr. Parmelee read a letter from Prof. Julus G. Pohlé, in which was described a small collection of minerals presented by Prof P. to the Institute. The first of these was a specimen of massive rutile, discovered by one of our soldiers in the valley of the Shenandoah. On analysis, it was pure oxyd of titanium. Another was a specimen of native sulphide of antimony from New Brunswick, where a vein nearly three feet in width exists. It contains a small proportion of arsenic. A specimen of rock salt from the Island of St. Domingo was also exhibited. In this island it exists in immense quantities. The specimen exhibited contained ninety-nine per cent of pure salt.

The chairman, after some preliminary business, announced as the regular subject of the evening,

Light and Color.

Dr. P. Vanderweyde took the floor and first called the attention of the society to achromatism. Its derivation is from the Greek *a* (privitive), and *chroma*, color. Achromatism refers to those principles by which we are enabled to free instruments requiring lenses from defects relating to color. These defects are, that objects viewed through them appear colored. If stars or other heavenly bodies be observed by the aid of a telescope, they will appear colored, and this coloration is due to principles which were afterward explained by the lecturer. The same defects are observable in the microscope. The reasons for this are as follows: When rays of light fall upon the surfaces of denser media than that through which they have been traveling they are refracted, and this refraction is not always the same. It varies with the direction in which the ray strikes the surface. Descartes has investigated the subject, and determined the law of this variation. But rays of light are not only refracted, but dispersed into various colors. This was treated of at a former meeting, and does not need to be here enlarged upon. It was found, however, within the past few years, that the dispersive power of

various media is independent of their refractive power. This fact furnished a clue to the solution of the problem of removing the coloration of bodies in the use of lenses. Flint glass has a greater refractive power than crown glass. If a lens of flint glass and a lens of crown glass be placed together, the curvature of each may be such that the dispersive power of each may be destroyed, while a part of the refractive power is retained.

Researches into the spectrum show that differently colored lights have different degrees of velocity. A difference between various matters is also observable in this respect. Some substances will only transmit rays of a certain velocity, while other media will allow rays of a different velocity to pass through them. Rock salt will transmit rays of a lower velocity than glass. Rays, therefore, which are not visible to the eye, or rays of heat, will pass through this medium which rays of light can scarcely penetrate. We are thus enabled to have a heat spectrum. The chemical rays of the spectrum may also be separated. Dr. Vanderweyde finally spoke of the great advances which have been made in the microscope, claiming that much is yet to be done in this field.

Experiments with Luminous Flames.

Mr. John Johnson then exhibited an apparatus designed to demonstrate that flames are composed of cones of different colors. The apparatus consisted of a long tube connected with the gas pipe by an India rubber tube; a small flame of gas may thus be obtained at the end of the tube. By shaking this tube violently around, the colors of the spectrum are to be observed in the flame. Mr. Johnson also explained a means for utilizing smoky hydro-carbon oils. The burning oils were placed under a Bunsen burner open at the bottom. The almost colorless flame of the burner was thereby rendered very bright, the unconsumed particles of carbon from the oil becoming incandescent in the Bunsen flame.

The society then adjourned.

April 29th, 1869.

Professor S. D. Tillman in the chair. Mr. C. E. Stetson, Secretary.

Dr. Tillman read the following interesting paper upon a subject which is at present attracting a good deal of attention:

Solar Spots.

The recent passage of a large spot across the sun's equator reminds us that just one hundred years have elapsed since Dr. Alexander Wilson, of Glasgow, after a careful series of observations, gave the first plausible explanation of this class of phenomena. He found that one side of the penubral fringe which surrounds a dark nucleus, forming the center of a solar spot, became narrower on approaching the central line of the sun's disk, and after passing it the same side of the fringe was widened, while the opposite side was gradually reduced in width. Hence, he inferred that these appearances indicated the formation of a vast funnel-shaped cavity in the sun's envelop. Ten years later, in 1779, Sir William Herschel investigated the phenomena more fully, and from the character of these spots made some deductions regarding the constitution of the sun, which have been generally accepted until within a very recent period. He supposed the sun to be mainly a dark mass, surrounded by two atmospheres; that nearest to the center being less luminous than the outer envelop, which is enormous in depth, of great brilliancy, and the source of all solar light and heat. When, therefore, the envelops were rent asunder, a portion of the sun's body would be seen as the dark nucleus, while in the penumbra would be revealed the shelving sides of the inner envelop. After Mr. Dawes announced the discovery of a rotary motion in sun spots, their action was assigned to causes similar to those which produced cyclones and whirlwinds in our own atmosphere.

The density of the sun is only one-fourth the density of the earth, while gravity at the surface of the sun is nearly twenty-eight times greater than that force on the earth; furthermore, the heat in the exterior of the sun is so intense that iron, nickel, magnesium, and other metals, which the spectroscope assures us form a part of it, are maintained in a state of elastic vapors; these and other considerations lead us to infer that the actual diameter of the solid, or perhaps only liquid, portion of our great central luminary is not more than one-half of its apparent diameter, consequently the dark nucleus forming the center of a solar spot does not have the significance assigned to it by the elder Herschel. Moreover, the existence of a separate envelop between the photosphere and the body of the sun is not essential to a satisfactory explanation of the changing aspect of a sun spot, since the shading of the penumbra is found to result from streaks of light falling from the more luminous into the less luminous portion below.

Solar spots appear singly or in groups within thirty degrees of the sun's equator, and from their position are supposed to be directly influenced by the rotation of the sun. They expand, contract and disappear with great rapidity, yet their peculiar formation precludes the idea entertained by some that the same spot can ever return. These spots are found unusually numerous in certain intervals of time. The veteran observer, Schwabe, of Dessau, who has for the last forty years made this subject his constant study, gives to sun spots a periodicity of eleven years, and has suggested that they may have some connection with meteoric showers. Prof. Wolfe, sometime since, expressed an opinion in the Paris *Comptes Rendus* that their appearance depended on the planets, Saturn, Jupiter, Venus and the earth. It has not yet, however, been satisfactorily shown that there is any direct relation between their periodicity and that of any other celestial phenomenon. So much is yet to be discovered before the problem of sun spots can be solved that the sun must remain for a long time the most interesting day study of the astronomer. The agitation of the sun's exterior is a subject of special wonder. Observations frequently made during a solar eclipse prove that portions of the gaseous exterior rise, as protuberances, to the height of 80,000 miles beyond its apparent surface. Many of the solar spots are known to exceed 50,000 miles in diameter and 2,000 miles in depth, while in the immediate neighborhood of the great spots the telescope reveals the movement of most luminous streaks called *faculæ*, and everywhere minute specks and pores which seem to be kept by the seething mass in constant fluctuation. Certainly, the most sublime idea of commotion which can be conceived will be derived from a study of that vast and incessant sweep of attenuated matter which forever varies, and yet preserves the form of the sun's surface.

The Velocipede.

Mr. John Johnson exhibited and explained a diagram illustrative of some points connected with the velocipede. The question involved seemed to relate to the power of a man as applied to such a machine, and measured in foot-pounds.

Mr. J. K. Fisher read from his note-book the results of certain investigations recently made in regard to the velocipede as a useful machine; that is, as one which accomplishes a fair amount of work in proportion to the amount of power applied. Referring to the experiments of Sir John McNeill in regard to traction on roads of

different kinds, he gave the following data, which are generally accepted as accurate:

Resistance in Pounds per Ton on Different Roads.

Iron floor...........................	8 lbs. per ton
Stone tramway.......................	12 lbs. per ton
Paved road	33 lbs. per ton
Macadamized road.....................	46 to 65 lbs. per ton
Gravel	147 lbs. per ton

In the case of the velocipede, allowing the resistance to be forty-six pounds per ton, the velocipede and the rider to weigh together one tenth of a ton, and the effective work of a man to be one-eighth of a horse, or 4,700 pounds raised one foot high per minute, then the velocity attained should be about ten miles per hour. This is more than a man can accomplish by merely walking. It will be seen, however, that if the resistance should be as great as that on a gravel road, the utmost power of a man would drive the machine only about three miles per hour, which is less than he could walk.

Dr. Vanderweyde.—In the velocipede we have a wheel say ten feet in circumference, and a crank of but ten or twelve inches. By moving our feet up and down to the extent of twelve inches, we propel ourselves a distance of ten feet; and, meantime, our entire weight is supported by the saddle of the velocipede. Surely, we are enabled to gain a great deal by this.

Mr. J. S. Whitney.—It is all very well to talk of the velocipede being a useful machine; but when we consider the constant mental strain which is kept up, owing to the amount of watchfulness required to maintain the proper balance, it will be obvious that riding a velocipede becomes very hard work. The amount of watchfulness required will be seen from the fact that one of our best velocipedists, who is also a very powerful man, tells us that merely passing over a nail in the floor has a perceptible effect on the machine. In addition to this there is the liability of getting spilt, for I can myself testify that in my attempts at riding the velocipede I found myself in some very undignified attitudes.

Dr. Vanderweyde.—Those who skate well make no such mental exertion. A poor skater is in constant danger, but to a good skater the keeping of his balance is a second nature, and he does it unconsciously and without effort. It will be the same with the velocipede; when a man has become thoroughly expert he will be in no danger of falling.

Dr. J. J. Edwards.—Yes; and when the gentleman was younger, it required a constant effort on his part to keep his balance, even though he was not mounted either on stilts, skates, or a velocipede. The art of walking has to be acquired by us all, and is no more natural to us than skating or riding the velocipede. And yet none of us find that it requires any mental strain for us to keep balanced on our feet.

In reply to a suggestion that the legs were the most natural means of locomotion, Dr. Tillman remarked that it was a well known fact that railroad laborers on a hand-car can propel themselves at the rate of eight or ten miles per hour, and keep up this speed for quite a distance. At the same time they transport quite a load of tools, rails, etc. This result is owing to the perfectly solid, smooth track on which the car is moved. Of course on the smoothest common road, such as a velocipedist seeks, they would make no headway in the hand-car.

Dr. Lambert.—Many here present have no doubt tried the hand-cars found at Saratoga and other places of amusement; and any one that has had any experience on the subject must confess that to propel one's self by means of these hand-cars is much more exhausting than to walk the same distance. One of our velocipedists, who is making $100 per week, was complimented the other day upon the ease with which he earned his money. "Ah," said he, "it is all very well to talk, but I never worked so hard in my life, and you would think so too if you were to try it."

Mr. Whitney.—All velocipedists will tell you it is the hardest kind of work.

Mr. Phin.—There are two points to be considered in this connection. The first is the fact that railroad laborers and others, whose muscles are trained to the work, can make fifteen miles per hour and not suffer from over exertion. In these men the peculiar muscles which are brought into play in this kind of work have been trained and developed. In professional men, like Dr. Lambert and others, the muscles of the arms are not so fully developed as those of the legs. We all use our legs to a certain extent, and the muscles employed in walking rarely get a chance to suffer from atrophy occasioned by want of use. But except in the case of workmen who wield the hammer, the jack plane, the saw, the crowbar, the hoe, or the pitchfork, the muscles of the arm are not exercised, and they become comparatively weak. To compare the amount of work per-

formed by the arms of a literary man with that effected by the arms of a blacksmith of the same weight, would be preposterous, although perhaps the literary man would outwalk the blacksmith. I have myself walked nearly fifty miles in a day, but I should have found it very difficult to propel myself that distance by my arms. The second point is the fact that in walking we do a great deal of useless work. Every time we take a step the center of gravity is raised and then allowed to fall. Now, if man were a mere machine, this falling of the center of gravity might be made to effect some work which would tend to increase the final result. According to modern theory, it might even be made to produce heat, but this heat would unfortunately be useless for the production of muscular force. Letting a man fall through ten feet will not restore the muscular exhaustion produced by his raising himself through that space.

Mr. Whitney.—It is true that in walking we raise the center of gravity a little, but in the velocipede we raise one leg a great deal, and the one balances the other.

Mr. Blanchard.—Yes; but one leg balances the other, and there is thus no loss incurred.

Dr. Vanderweyde.—In the velocipede the weight of the body is entirely supported, and every motion made by the feet is greatly multiplied in the final result. It is nonsense to talk of the effect of awkwardness in considering the mechanical results produced by any machine.

New Instrument for Cutting Glass.

Mr. J. Johnson gave a very lucid explanation of a new instrument made of steel, which he had just seen and used, and which cut glass as well as the diamond. Unless some unforeseen objection should arise, it promised to be of great utility.

Street Sweeper.

Mr. Adolphus Wurth exhibited a machine which he had invented for sweeping the streets. It was similar in construction to machines for this purpose which have been previously presented.

Mr. Fisher.—The only true street cleaner is water. Sweeping does little or no good. Wash your streets with water and blow the water out of all holes, and then you will have clean streets. Or, better yet, have your streets so perfect that there shall be no holes in them.

An inquiry was here made as to the amount of damage caused to furniture, clothing, etc., by the dust in the city of New York. No direct reply was given to this question, but it was stated that Mr. Edwin Chadwick estimated that the dust of London entailed upon the inhabitants an amount of extra washing which was not less than £1,000,000 per annum.

Dr. J. V. C. Smith hoped that the time would come when steam carriages and good roads would effectually abate this nuisance.

The interesting article was read by the author—

On the Computing and Comparing of Indicator Diagrams.

G. H. Babcock.—It is a fact well known to engineers, that by none of the ordinary methods of expressing the comparative merits of different engines, can a satisfactory conclusion be reached as to the value of any peculiar construction, unless all the conditions and circumstances under which the comparison is made are precisely similar. The amount of coal burnt per hour per horse-power is a common criterion, but so many other conditions than that of the construction of the engines enter into and effect the result, such as the evaporative efficiency of the boiler, the quality of the fuel, the load, the amount of protection to the boilers and pipes, from radiation, etc., that it affords no just criterion by which to judge the perfection of the engine alone, unless these several conditions are all equal in the classes in which a comparison is desired.

The amount of water required per hour per horse-power gives a much nearer approximation to the relative value of different engines; but in this comparison, also, it is necessary that the load relative to the capacity of the engine, the quality of the steam, whether dry or wet, and all the exterior conditions should be precisely similar, to render the comparison just. But even when the exterior conditions are similar neither of these tests give any result by which can be determined, save by inference, the relative advantages of different mechanical arrangements or proportion of parts. It being almost impossible, except by special construction for the purpose of experiment to find two engines under circumstances where the sole difference is in some specific point of arrangement or proportion, the precise effect of that difference cannot be determined by the consumption of fuel or water.

The use of the indicator is the most satisfactory way yet devised for ascertaining the relative efficiency of various constructions and

styles of engines, under differing conditions; the shape of the diagrams produced by this instrument giving to a practiced eye, but only to such, an indication of the relative perfection of the valve motion, the size of the passages, and the general efficiency of the machine. But it is desirable to be able to compute these diagrams in some way which will give a mathematical expression of their several grades of efficiency, and thus enable us to express the comparative values of different forms of construction, independent of the varying conditions under which the diagrams have been taken, and a method of accomplishing this object forms the subject of the present investigation.

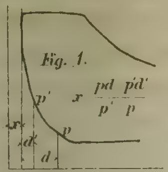
It is evident that an engine which has no losses from clearance, condensation or leakage; which takes the steam at boiler pressure until the point of cut-off, expanding in accordance with the hyperbolic formula, exhausting at the end of the stroke to atmospheric pressure, or to perfect vacuum, according as it is condensing or non-condensing, performing the back stroke with no back pressure (back pressure being reckoned from atmosphere if non-condensing, or vacuum if condensing), and compressing, if at all, on the hyperbolic curve, would give the utmost power which could be obtained practically from that amount of steam used under that pressure and degree of expansion. And it being self-evident that the engine which approaches nearest in its action to the above has the best proportions and arrangement of its mechanism, we will adopt it as a standard, and proceed to institute a comparison of the diagram made by a given engine, with this standard engine, having the *same capacity* (including clearance) *and using the same amount of steam with the same boiler pressure;* that is, we propose to compare each diagram with a diagram calculated for a theoretically perfect engine under precisely similar circumstances.

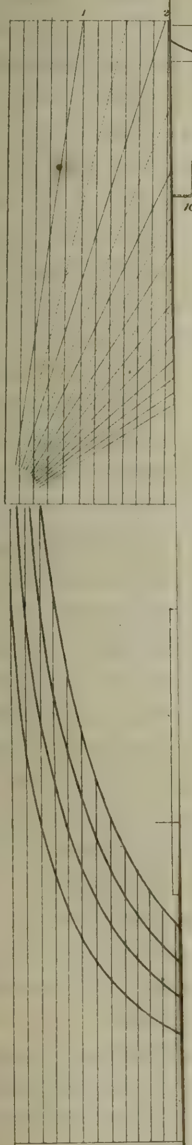
The amount of steam expended in producing the power developed in any particular case, is measurable in two ways: By the amount which enters the cylinder, and by the amount which is discharged therefrom. Had we the exact means of measuring either of these quantities, we should, of course, find them precisely equal; but, owing to the unavoidable condensation within the cylinder, part of which is reëvaporated during expansion, and of more or less leakage into the cylinder after the valves are closed, the indicator diagram nearly always shows an apparently greater quantity of steam exhausted than received. The exact point of cut-off or suppression

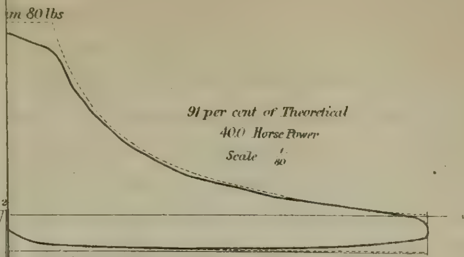
is, in most cases, also very difficult of determination by means of the diagram, while it is not difficult to decide upon the point of exhaust, with sufficient accuracy for our present purpose; consequently a nearer approximation to the true amount of steam used, may be obtained by measuring the steam exhausted than by the induction.

But it should be remarked here, that the indicator diagram does not show the full quantity of steam used under any circumstances; as there is more or less water evaporated from the interior surfaces of the cylinder during the return stroke of the piston, while the exhaust valve is open, the steam from which evaporation does not show on the diagram, but nevertheless carries off a quantity of heat that has to be replaced by the condensation of more live steam, while the induction valve is open, on the return stroke, and this steam also is unrepresented upon the diagram. Again, there may be, and often is a leak from the cylinder either past the piston or exhaust valve, during the forward stroke, which may be detected by, but is not measurable upon, the diagram, although a leak into the cylinder is shown by a higher terminal pressure. There is, consequently, a quantity of steam used which it is impossible to estimate by means of the indicator alone, the effect of which upon this investigation will be considered hereafter.

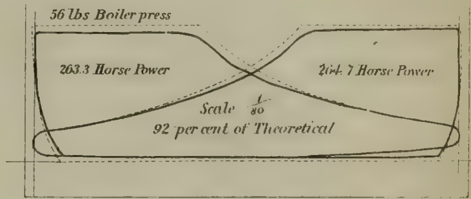
Having assumed, therefore, that the terminal pressure represents a sufficiently near approximation to the quantity of steam used in developing the power represented by the diagram, we will proceed to construct a diagram of a theoretical engine of the same capacity, including clearance, as the engine under consideration, and having the same terminal pressure. But in order to do this we must first know the pressure of steam in the boiler and the clearance in the cylinder and passages. The former is generally given on the diagram, and, where practicable, should be corrected by testing the gauge with the indicator spring. The clearance is, however, rarely given, and varies in different engines from one and a half to ten per cent per of the space swept through by the piston in one stroke. If we have the drawings of the engine we can calculate it; if we know the style of engine we can approximate it; and if there is any compression, we can estimate it from the diagram, by assuming any two convenient points in the curve, measuring the pressure from absolute vacuum at those points, and their distance from a line vertical to the vacuum line, and touching the end of the card; thus in Fig. 1, let p = pressure and d = distance of the first point, or the one far-



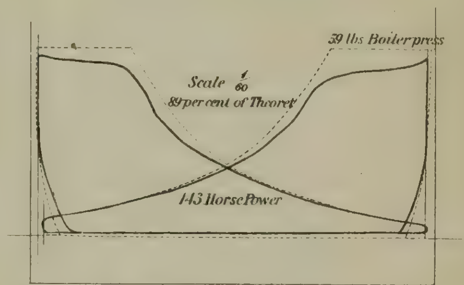




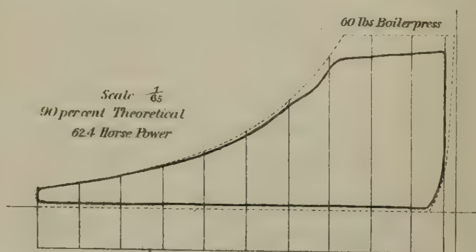
Babcock & Wilcox Engine DRUID MILL
Cyl. 28 ins Dia 72 ins Stroke 46.8 Revol



Babcock & Wilcox Engine ATLANTIC MILL
Dia of Cyl. 26 ins. Stroke 4 feet. 60 revol.

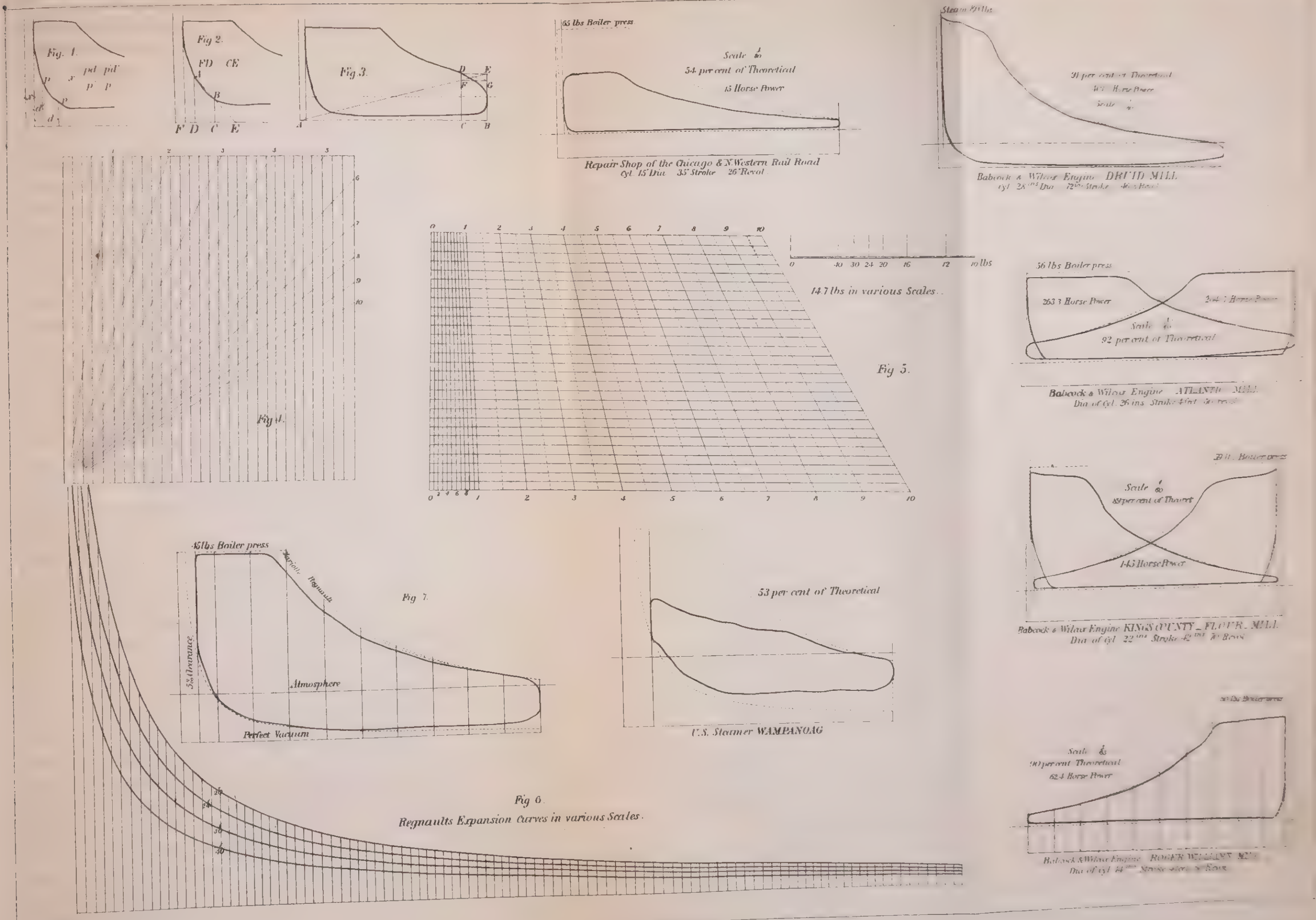


Babcock & Wilcox Engine KINGS COUNTY _ FLOUR _ MILL.
Dia of Cyl 22 ins Stroke 42 ins 70 Revol



Babcock & Wilcox Engine ROGER WILLIAMS MILL
Dia of Cyl 14 ins Stroke 4 feet. 60 Revol.

Indicator Diagrams



thest from the end of the diagram, p' and d'=respectively the same quantities for the other point, and x=the clearance, then $(x+d)\,p=(x+d)\,p'$ and thence we have the formula $x=\frac{pd-p'd'}{p'-p}$

p and d may be measured in any convenient scale, and x will be in the same scale as d. Or we may determine the clearance geometrically by the following construction (see Fig. 2). Assume two points A and B in the compression curve, and connect them by a right line A B, continuing this line until it cuts the line of no pressure, F E at E. Draw A D and B C perpendicular to F E, and make F D = C E. Then F is the end of the theoretical diagram including clearance, and the distance of F from the boundary of the indicator diagram is the clearance in the scale of the length of the diagram, which represents the stroke of the piston.

Having determined the clearance, we proceed to lay out the theoretical diagram as follows: We first draw a line representing the boiler pressure, which is given in the scale of the instrument, and also a line of no pressure or perfect vacuum, at 14.7 pounds from the atmospheric line, unless the true barometric reading is given. We then divide the length of the diagram, including clearance, into a number of equal parts, generally ten, though any number will answer. We next measure the pressure at the point of exhaust, which is usually a little before the end of the stroke, and find the terminal pressure therefrom either by the inverse proportion of the distance from the commencement of the diagram to the whole length, or by the method shown in Fig. 3, in which A B is the length of the diagram including clearance, and the line of no pressure, and D is the point of exhaust. Draw D E parallel to A B, and join A E cutting D C at F. Then draw F G parallel to A B, and B G will represent the true terminal pressure, or in other words, the tension at which a quantity of steam equal to the whole capacity of the cylinder and clearance is discharged at the termination of the stroke.

Having thus found the terminal pressure, the pressure at any other point of the stroke is easily found by the usual formula, or what is known as Mariotte's law, in which the pressure increases inversely as the distance from the commencement of the stroke. Where there are ten divisions of the diagram, the several ordinates of the expansion curve may be obtained by multiplying the terminal pressure by the following series of numbers: 1., 1.11, 1.25, 1.429, 1.667, 2., 2.5,

3.333, 5., 10. Having found the theoretical pressure at each of the several divisions of the diagram, we then trace a curve through these points; and where the curve thus found intersects the line of boiler pressure, is the point of theoretical cut-off at which the admission of steam must be suppressed in our theoretical engine to give the same terminal pressure.

On the return stroke, if there is no compression, the theoretical diagram will follow along the atmospheric line or the line of absolute vacuum, according as the engine from which the diagram was taken is non-condensing or condensing, and will extend to the clearance line, and up that to boiler pressure. But if the exhaust valve closes before the end of the return strokes and a quantity of steam is imprisoned in the cylinder to form a cushion, then so much of the cylinder full of steam as is thus imprisoned, is not discharged, but remains in the cylinder, and must be allowed for in our theoretical diagram. We therefore draw a hyperbolic curve tangent to the actual compression line, and extending to the line of boiler pressure, which curve forms the boundary of the theoretical "card." If the engine is condensing, this curve will also extend to the exhaust line, and will form the boundary of the theoretical diagram both on the bottom and at the end. If non-condensing the atmospheric line will bound the diagram until it intersects the compression curve.

We now have two diagrams tangent at two points, the compression and exhaust; the one always larger and inclosing the other. The inner one represents what the steam actually performed in the engine, the outer one what the same amount of steam should have done in a perfect engine of the same capacity; and the proportion which the area of the smaller bears to the larger, gives a very good idea of the relative perfection of the mechanism which was used for developing the power of the steam. This may be expressed in percentage of the theoretical, and a collection of diagrams so figured, the arrangement of valve-gear in each case being fully noted, is very instructive.

To facilitate the construction of these theoretical diagrams, Mr. A. H. Raynal has devised the scales shown in Figs. 4 and 5. Fig. 4 is for laying off the hyperbolic curve of expansion with rapidity and without the mental effort incidental to mathematical calculations. It is simply a series of secants numbered from the vertical, whose tangents are to each other inversely as their numbers. In using this scale, which answers for all scales of pressure, and any number of

divisions of the diagram, we take the terminal pressure in the dividers, or on a slip of paper, and find with which of the vertical lines it corresponds, at the secant corresponding with the number of parts into which the diagram is divided; and each of the other pressures will be found at the intersection of its corresponding secant with the same vertical line, and may be transferred directly to the divisions of the diagram. Should the number of divisions exceed ten, the dotted secants are used. They also serve for semi-divisions of the diagram, where accuracy requires them; as where the point of cut-off is quite early in the stroke. It is not essential to determine the terminal pressure in all cases, but frequently it will be sufficient to take the pressure at the ninth, or any convenient division, and from that point lay off the curve each way.

Fig. 5 is a device for laying off the divisions of the diagram, including clearance, the length of diagram and percentage of clearance to stroke being known. It is a diagonal scale with one of the divisions subdivided in a progressive ratio. In using it, the length of the indicator-diagram is taken on a slip of paper, and so placed upon the scale, that while horizontal, one end rests upon the subdivision which represents the percentage of clearance, while the other end is at the extreme line of the scale; the several principal divisions of the scales are then marked on the slip of paper, the distance of the exterior line from the percentage subdivision mark being the clearance in the same scale as the stroke. When the length including clearance is given, this scale is used simply as a proportional scale of parts. With this is given a scale 14.7 pounds in various scales of pressure, a very convenient adjunct for laying down the line of no pressure or perfect vacuum.

Let us now consider briefly, the effect of condensation and leakage of the piston or exhaust valves; and whether these so modify the results so obtained by this mode of comparison as to render it of little value.

Of course, any cause which lowers the terminal pressure, will decrease the size of the theoretical diagram in any given case, and thus give the engine a higher than its proper rate. Leakage from the cylinder produces this effect, and when this exists to any considerable extent, the diagrams are worthless for any other purpose than a measure of power. As the amount of such leakage is not measurable upon the diagram, it is important, when diagrams are taken for the above investigation, or in fact for any purpose, that this point

should be determined. This may be done by blocking the engine upon either half stroke, and letting on a full head of steam. By then examining the exhaust, the leakage, if any, will be detected, and may be measured by causing it to be condensed in cold water, weighing the water both before and after a given time; or by noting the rise in temperature of a given weight of water.

But the question of re-evaporation of condensed water within the cylinder while the exhaust-valve is open, is not so easily determined. It may be, and has been measured, by using a surface condenser weighing the water discharged therefrom, and comparing it with the weight of steam exhausted, as determined by the capacity of the cylinder and passages, and the specific weight of steam at the terminal pressure, and has been found to vary from nine to fifty per cent of the whole amount of steam used, according as means for its prevention have been used or neglected.

This loss, if measured and accounted for in the theoretical diagram, would reduce the apparent rate of the engine; but as it is nearly the same in all cases, having the same amount of protection to the cylinder, and is, in a measure, independent of the mechanism of the engine, we may ignore it in the foregoing calculation, without seriously affecting the value of the latter as a means of comparing the efficiency of one engine with another. But we should bear in mind in such comparison, that the effect of this practically unavoidable loss is, in all cases, to belittle the performance of an engine having a good degree of expansion within the cylinder when compared with one having little or none; because, in the former, a portion of the reevaporation occurs during expansion, and enters into our calcula, tion. We should also remember that when a steam-jacket is employed, its usefulness is not fully apparent in this mode of comparison, for the principal benefit of the steam-jacket being to lessen the loss by condensation, and to increase the proportionate re-evaporation during expansion, the saving in condensation is not represented, while the increase of re-evaporation during expansion, raises the terminal pressure, and thus lowers the percentage of the indicator diagram.

It will be seen that in this mode of comparing the performance of engines, the questions of the relative economy of expansion or non-expansion, of high or low pressure, condensing or non-condensing, are not mooted; the comparison merely being as to the relative value of the mechanical arrangement for utilizing the steam used at the particular pressure, and degree of expansion, and under the cir-

cumstances which are employed in the engine. But it clearly shows why an engine which admits the steam at or near boiler pressure, and automatically cuts it off at a point in the stroke proportionate to the load, is more economical than one which has a fixed or no cut-off, and a variable load, the power and speed being regulated by a throttle-valve. It also shows graphically the benefit of large passages and pipes, a tight, quick moving valve, and a proper amount of compression.

This mode of expressing the value of mechanical arrangements in steam engineering, was first published, it is believed, in a pamphlet issued by the firm of which the writer is a member, about a year ago. As it was not practicable in the limits of an advertising pamphlet to fully elucidate the grounds upon which the comparison was based, and because many even among the profession do not seem to understand the mode of delineating the theoretical diagram, I have taken the present occasion to enter into a more explicit description and explanation of what I believe to be a new and interesting investigation.

In the foregoing, I have assumed that steam expands according to Mariotte's law, for the reason that were it a perfect gas instead of vapor, it would follow that law in its expansion, and it is not improper, for the purpose of comparison, to so consider it; while that law admits of a ready construction of the theoretical diagram without the necessity of tables or pressures, or the use of logarithms. But should any one prefer to use the modified law of expansion of steam deduced from the experiments of Regnault, the Franklin Institute and others, it can be done by employing the tables of pressures and volumes given in most collections of engineering formulæ. To facilitate this, I have constructed the scale shown in Fig. 6, which is a series of expansion-curves, as per such tables, laid down to different scales of pressures. The terminal pressure having been ascertained, the same is found on the curve having the same scale of pressure as the indicator diagram. The distance between that point in the curve and the line of no volume is then divided into as many divisions as there are in the diagram, and at each division will be found its corresponding pressure.

This curve may be also described by first finding the ordinates of a hyperbolic curve, based on a terminal pressure equal to the 0.941 power of the true terminal pressure, and then extracting the 0.941 root of each of these ordinates.

The curve thus found is always exterior to that derived from Mariotte's law, as seen in Fig. 7, which is a diagram fully developed in accordance with the foregoing directions, and with both curves of expansion delineated. Several diagrams from various engines, compared in the foregoing manner are appended to illustrate the principle.

At the close of this important paper, a gentleman referred to the method of estimating the area of the diagram by cutting it out of paper and weighing it. The weight of a square inch of the same kind of paper being known, the area of the indicator diagram is easily calculated. This method has been recently brought into notice as something "very novel." It is, however, to be found in some very old works on mensuration. It gives very accurate results, but requires the aid of a very delicate chemical balance. Common scales will not answer.

Adjourned.

DISCUSSIONS

OF THE

PHOTOGRAPHICAL SECTION

OF THE

AMERICAN INSTITUTE.

May 4th, 1868.

Joseph Dixon, Esq., in the chair. Oscar G. Mason, Secretary.

Mr. Daniel Chapman, chairman of the committee appointed at the last meeting, at the request of Mr. Charles B. Boyle, optician, to report on the fidelity of his drawings as figured in the *Philadelplia Photographer*, for January, 1868, reported that the committee were unable to detect any attempt at misrepresentation on the part of Mr. Boyle. This report was accepted and the committee discharged from further duty.

Prof. Vanderweyde exhibited several single and combination lenses used for photographic work, and illustrated his remarks upon their uses and relative value, by a series of photographs, showing their working qualities. Many of the pictures were very fine, especially one of Girard College.

The Hon. E. G. Squier, being present, was called upon to give some of his experience in making photgraphs in South America.

Mr. Squier said that, though he had sought a connection with the Institute mainly in order to establish a relationship with the photographic section, he was sorry to say that his knowledge of the noble art of photography was limited indeed. He did not understand much of its technical phraseology, still less of its rationale. He had taken photographs of men and things with more or less of success, and expected to take more. But his appeal to the art was purely that of a traveler, and it was in the utilization of it to the wants of the traveler, that he was mainly interested, and to this that he wished to

call the attention of the men, theoretical as well as practical, that he saw around him. He came to them as the representative, in an humble way, of a class who needed their instruction and aid in the common, grand purpose of increasing and diffusing knowledge. The traveler and explorer understands that he cannot adequately do his work, in this second decade of the last half of the nineteenth century, without the assistance of the photograph. Travelers' tales become travelers' truths, when the camera and lens are brought to their illustration and indication. Every drawing is liable to impeachment. A description may be more or less clear, or more or less exaggerated. But photography paints its own picture through the subtle pencil of the most glorious object of creation, which has ever been the accepted symbol of that Divinity whose essence is Truth.

He had gladly accepted a mission to the government of Peru some years ago, not alone in the hope of being able to adjust the differences long existing and much aggravated, between the United States and that Republic, but with the hope, also, of illustrating the monuments of the most interesting, and, in many respects, the most advanced of all the aboriginal empires of this continent. He had been educated as an engineer, and could make plans "as well as the next man;" had edited newspapers, and written books with moderate success; felt, no doubt, he might tell his story in an intelligible manner; could draw a horse so well, that he had never (but once), had his picture mistaken for that of a rabbit; but felt that the requirements of modern science and modern research could not be met without the aid of the unerring photograph.

So, when he was prepared to leave Lima for the Andes and the Amazon, his first care was to engage a photographer, as much as possible for the glory of the enterprize, and as little as possible for the sordid consideration of money. And he might here mention the novel fact that travelers are never overburdened with money. There never was a traveler, that he knew of, by the name of Astor, or Girard, or Stewart. Well, he found photographers in plenty; but why it should happen that gentlemen of that persuasion (he was speaking of those outside of the United States) should necessarily be spiritualists and corn-doctors, and inordinately addicted to strong drinks, he could not understand. That they were generally so, a decent regard for truth compelled him to confess.

He would say nothing of the two months spent in preparation. How he bought out all the apothecaries in Lima and Callao; exhausted

the stock of vendors of glass, and stripped the market of black and yellow muslin for a tent, etc., etc.,

The bills of his photographer were portentious, and the articles of which they related made nearly three full mule-loads. And all this was to be carried up and over the Cordilleras, 18,000 feet above the sea, where barley straw costs sixteen cents a pound, and a wretched drench, called *chupe*, more than a dinner at Delmonico's. It was a wonderful and fearful agglomeration, that photographic outfit, with gold at 280 in New York, and only to be had on sight drafts.

Whether it was from spiritualism, or native rum, or something else, he could not undertake to say; but one bitter night, under the keen stars that shone out weirdly from an ebon sky, and with nobody except some rude but kindly Indians to assist him, he tried vainly to compose the mental hallucinations of his photographer and companion, who died before morning, murmuring something in the Gaelic tongue, in which the endearing term of "mamma," common to all languages, and sacred in all, was alone intelligible, and the last on his thin, blue lips, the pass-word to a better world!

"I found myself next day," continued Mr. Squier, "not only alone in the great American Thibet, but incumbered with bulky apparatus, and a large amount of material. To utilize them, I found no instruction except such as is contained in that lively and lucid book, 'Hardwick's Manual of Photographic Chemistry,' including (and here is where the laugh comes in) the 'Practice of the Collodion Process.' If you discover any silver streaks in my beard, or other evidence of premature old age, you will now know to what to ascribe them. The last syllable of Mr. Hardwick's name is a pleonasm. Now, I do not doubt that '$HJ + NO_4 = HO + J + NO_3$' is an exact formula, but it is not altogether a pleasing one to encounter, when one is all alone among the Andes, with three mule-loads of bottles and other things, which he must try to utilize, or surrender the object of all his labor and outlay.

"How I made baths and collodion in low-thatched, Indian huts, staining my fingers and spoiling my clothes; how my ether went off with a bang, on the shallow pretext of being too closely approached by the dimmest of all dim tallow dips; how my *arriera* nearly died from taking a surreptitious swig of Atwood's 95 per cent alchohol, and afterward nearly murdered me by bringing glacial acetic acid when I asked for vinegar; how—but gentlemen, if you want to know how, forget all you ever knew about photography, and go up among

the Andes where the thermometer is 'steady' at zero, with three mule-loads of chemicals and instruments, and 'Hardwick's Manual and Practice.'

"But badinage apart; how photography may be best utilized for the purposes of the traveler, it seems to me, is a problem worthy of engaging the attention of the practical professors of the art. Unfortunately, however, there are few of these professors who know all difficulties which beset the traveler, especially in remote, savage, or, half civilized countries; where, perhaps, neither house nor hut is to be encountered for days and weeks, where the weather is fervid or freezing, the earth overshadowed by forests, or overflowed by water, or else desolate and dry; where always, above all things else, transportation is expensive, difficult or impossible to be had, and where the baggage of the traveler requires to be reduced to a minimum.

"The traveler does not expect to take fine pictures, to be exhibited as among the highest achievements of photographic art; but he wants to obtain fair results, cheaply and rapidly. And to do this he must have his apparatus compact, dispense with tents, be able to get along, for a reasonable time at least, without water, and with the least possible amount of that heavy and fragile material called glass. He must also be able to do his whole work without assistants, who are seldom to be had, or when had, are sometimes worse than none at all.

"But above all, he wants a manual, simple in language, clear in direction, brief as a primer, which shall tell him what to do, and not why anything is to be done. Many travelers have a certain knowledge of chemistry, and most a fair knowledge of things in general. But they seldom have the time or inclination to perfect themselves in photographic chemistry. They want the instruments and the materials, with plain instructions for their use. I have the reputation, throughout most of Central America, of being a great and almost infallible *medico* or doctor. Until I went there I trusted my health and life to my physician, and asked no questions, just as I should trust my head to Saxony; but I was going where there were few physicians, if any, on a long and dangerous exploration, in a strange tropical region, with its peculiar diseases. Well, what did I do? I went to Rushton & Clark, a othecaries, told them where I was going and what I was going to do, and asked them to fit me up a medicine chest, with medicines and plasters, and other things most likely to be required in case of illness or accident, and to write

in ten words what I was to do, how and when, and without a why or wherefore. The day before I sailed, they supplied me with a little leather box, precisely nine inches long, five inches broad, and six inches deep, with two stories of bottles and a basement containing scales, pills, plasters, etc. And a little primer, partly printed and partly manuscript, four inches long, three inches broad and two-tenths of an inch thick; not quite so large as Hardwick's. With this little box and these simple directions, I have traveled, as an Irishman would say, in five of the four quarters of the globe, working cures and keeping myself in such comfortable condition as you see. It is precisely something like this that the traveler requires in the matter of photography.

"I am aware, that my friend Mr. Hull would recommend 'the dry process.' But besides being too slow, it is uncertain; and a traveler cannot turn back to take a second view, when at night he finds his first one has failed, especially when his supply of food for man and beast is short, and his very life depends on getting through 'on time.' And again, in secluded regions, the natives are timid and suspicious, and would face a columbiad as soon as a lens. You have to take them, so to speak, 'on the wing,' and for many reasons it is often of first importance to science to present the people you travel amongst, as they are. Trees and plants, as well as men and animals, have also an unfortunate habit of not keeping still for any considerable time. The process of the traveler must be a quick one.

"Preparing plates with honey, etc., etc., answers to a certain extent, but everything that complicates a process and requires new materials is a nuisance and encumbrance to the traveler. And then the tent, and for that matter its substitutes, are all a vexation of the flesh and the spirit, and provocative of profanity. Besides the time it costs to rig them, it happens, most frequently, when and where they are most needed, there is no room for them, or the wind blows so strongly that they will not stand, and the poor traveling experimentalist suddenly finds himself smothered under the canvass, with his collodion spilt in his hair, and his bath over his stomach.

"Oh, ye dwellers in 'galleries' with roofs of tinted glass, and dark chambers elaborately fitted, with water *ad libitum*, and all that! Go forth into the wilderness, and if you do not know anything of photography, take Hardwick with you, 'and may the Lord have mercy on you!'

Mr. Squier said that during his visit to the Paris Exposition, he

had devoted some time and attention to what had been done to meet the photographical wants of the traveler, and had seen and purchased a number of devices, which, more or less, met these wants; but, he was satisfied that the best result had not yet been obtained. He would take pleasure of exhibiting, at another meeting, the Dubroni apparatus, which, however, was little more than a toy, requiring a care in cleansing after each operation, always difficult and sometimes impossible to bestow. The Anthoni apparatus was better, but unsafe and unmanageable, precisely under the circumstances when it would be most needed to work exactly. The best apparatus was that of Albite's, on which he (Mr. Squier), had made some improvements. This, he thought, was on the right principle, and contained more nearly than any other he had seen, the elements of success. He would show this at an early day.

A great desideratum was, of course, to dispense with carrying glass. He had had some success in removing the film from the plate, and thought that would be the way, and the best way, of meeting an important requirement in what he would call peripatotic photography. Better, probably, than through paper negatives. Since, however, his own necessities had exacted his attention to these matters, he had learned something, and wanted to learn more about microscopic negatives and their practical availability. Perhaps, through means of these, and by the suppression of the dark chamber, or rather by its modification, so that it would cease to be an obstacle and a nuisance, the whole solution of the problem of the utilization of photography for the traveler and explorer would be complete. How well these microscopic negatives might be "thrown up," he did not know, and it was a process in which he sought light and information. Travelers are usually authors, and authors are often travelers. And all feel the importance of a direct appeal to the eye of the reader in conveying or illustrating ideas that no mere words can convey.

The application of photography to what is called engraving, he regarded as a subject worthy the best attention of scientific photographers and practical printers, and he was happy to know how much was doing in that direction. Many of his illustrations for his work on Peru, were in course of execution from impressions direct from his negatives on the block. But that next step was to absolutely dispense with that costly assassin of all life and truth in a picture, the engraver, through some device for relief photographic printing. He meant a practical and economical device. Mr. Squier made some

additional remarks on silver baths, as modified in action by climate and other conditions, and concluded by promising to exhibit at a future meeting some of the proofs from his negatives taken in Peru, at the same time apologizing for having encroached so much on the attention of gentlemen who were a long way in the photographic algebra, while he was floundering among the simple rules of photographic arithmetic.

Mr. Squier was listened to with the closest attention, and resumed his seat amid the plaudits of his listeners.

Prof. Vanderweyde thought that the glycerine process was best adapted for the use of travelers. He also explained the method of working a peculiar apparatus for landscape photography, which had been recently introduced in France.

Mr. C. Wager Hull had known of but one successful use of glycerine in photography, and that was for the purpose of keeping the surface of the plate moist, after development of the image; thus allowing an opportunity for redevelopment, after returning from the field work. He thought some of the dry processes might be so modified as to answer all the requirements suggested by Mr. Squier, and he believed that many more negatives would be secured, as the trouble and labor of unpacking and setting up apparatus for working, wet plates would often prevent the photographer from securing interesting and important views, while a dry process would require a halt of but a few minutes when on the march.

Mr. D. Chapman described a simple method for producing views by attaching the lens to the side of the dark tent, and placing the sensitized plate within the focus without a camera box.

Mr. A. J. Drummond exhibited several carbon prints which he had made on Swan's carbon tissue paper. He attributed the blistering of the films to the imperfect action of the rubber solution used in transferring the print.

Mr. J. Dixon described a case of the peculiar action of oxalate of chrome and potash, which was used in cleaning glass shades for the microscope. The crystals adhered so firmly to the glass that their removal abraded the surface sufficiently to destroy all polish.

Mr. John Johnson, of Saco, Maine, gave an interesting description of experiments, in which Mr. Garfield of Boston, Massachusetts, was engaged, with a view of determining the change produced in glass by exposure to sunlight.

Prof. P. Vanderweyde exhibited a series of card-size photographic views from Holland.

The section then adjourned to the first Tuesday in June.

June 2, 1868.

Joseph Dixon Esq., in the chair. Oscar G. Mason, Secretary.

Mr. C. Wager Hull presented several numbers of the "Mittheilungen fur Photographic," published at Berlin, Prussia, which he had received for the section.

Professor S. D. Tillman read from *Humphrey's Journal of Photography*, an account of experiments recently made by Mr. McLochlan, of England, who claims to have discovered a method of obviating many of the perplexities appertaining to photography, by so modifying the negative, sensitizing both as to admit of its being worked in an alkaline condition, rendering it more sensitive, and less liable to derangement by the absorption or solution of organic matter. The article called out considerable discussion, which was warmly entered into by several members. On motion of Mr. H. J. Newton, the chair appointed a committee consisting of Messrs. Newton, Mason, Chapman, and Vanderweyde, to experiment upon the theory advanced by Mr. McLochlan, and report at a future meeting of the section.

Prof. Vanderweyde translated from the "Mittheilungen fur Photographic," an article upon "phosphorescent photography." The image was produced upon an albumen substratum, by the use of sulphate of baryta and gum tragacanth finely pulverized. The image is rendered more permanent by a thin coat of paraffine.

Mr. D. Chapman exhibited a print made from an instantaneous negative, developed with the ordinary iron developer, after which it was washed and then redeveloped with the following mixture: Water, one ounce; carbonate of ammonia, ten grains; pyrogalic acid, eighty-five grains; alcohol, one ounce; and two minims of a five grain solution of bromide of potassium.

Mr. H. J. Newton said he had produced good negatives with an exposure of six seconds, by using an alkaline developer as follows: Three ounces of water at 150 degrees F.; a twenty grain solution of carbonate of ammonia, one drachm; a twenty-five grain solution of bromide of potassium, one-fourth drachm, a fifty grain solution

of pyrogalic acid in alcohol, one-fourth drachm. He placed the exposed plate in a mixture of the first three, and after allowing it to remain a short time he mixes the pyrogalic acid solution with it, in a graduated glass, and flows the whole over the plate until all details of the image are visible, then washes the plate in pure water, and flows with a solution consisting of water, eight ounces; proto-sulphate of iron, one-half an ounce; citric acid, one-eighth of an ounce; a fifteen grain solution of nitrate of silver, and as much of this solution as may be found necessary to render the image sufficiently intense.

Mr. C. W. Hull called attention to the use of sulphuric acid for drying tannin plates, as recommended by Mr. Cary Lea of Philadelphia. Several members discussed the propriety of drying plates by such means, and the probable action of the acid upon the film, some members believing that it would be rendered less sensitive.

Prof. S. D. Tillman read an article upon vitrified India rubber or leather collodion.

Mr. A. J. Drummond stated that he had made a similar substance by adding a small quantity of castor oil to the India rubber transferring solution used in the carbon process of Mr. Swan. In answer to a question by the chairman, Mr. Drummond said that the "blistering" in carbon prints might be avoided by first soaking the prints in cold water with the face down, by which the air between the film and paper was brought through the paper, and could be removed by passing the fingers over the surface while under water.

The section then adjourned to the first Tuesday in October next.

October 6, 1868.

Vice-President Charles A. Joy, in the chair. Oscar G. Mason, Secretary.

Mr. H. J. Newton, chairman of the committee appointed to experiment with the alkaline process, introduced by Mr. McLochlan, reported progress. He had rendered his negative bath alkaline by adding ammonia and cyanide of potash; he then exposed the solution to sunlight six weeks, and, upon trial, found it in most excellent condition for work. Some of the results produced were laid before the section, accompanied by a sample of the sensitizing bath and test proper, for the purpose of showing more clearly its condition.

Mr. S. A. Thomas remarked that he had rendered his bath alka-

line by the addition of caustic potash; he then exposed it to sunlight six weeks, with results very similar to those exhibited by Mr. Newton.

Mr. Daniel Chapman said he had used oxyd of silver and concentrated ammonia in his bath solution, and after exposure to light five weeks, found it capable of most excellent results.

Mr. O. G. Mason stated that he had used oxyd of silver to neutralize the free nitric acid in the crystals of silver, and then used cyanide of potassium in sufficient quantity to produce alkaline reaction. He exposed the solution to sunlight on the 28th of June last, and had not yet taken it in for trial.

No report had been received from Professor Vanderweyde on this subject.

Each member of the committee working independently, and by varying formula, so far as heard from, and yet arriving at substantially the same, or quite similar results, seems to warrant a conclusion that Mr. McLochlan's discovery is an important one, and worthy of trial by all photographers.

Mr. H. T. Anthony exhibited a very fine negative, in the production of which he had used a bath rendered alkaline by the addition of cyanide of potassium, and then exposed it to sunlight about ten hours. He also stated that he had used nitrate of ammonia in his sensitizing bath for glass positives, and found that it enabled him to produce greater harmony and more delicate details, besides rendering the solution less liable to change in its working qualities. Mr. Anthony also exhibited and donated to the section a series of stereographs which he had toned by the usual process, and fixed in a bath of hyposulphite of soda, to which he added a sufficient quantity of citric acid to redden blue litmus paper, and afterward added carbonate of soda until the blue color of the paper was restored; in which state the solution has a slightly milky appearance, which Mr. Anthony believes to be caused by the liberation of sulphur which is held in suspension.

By request of Mr. Anthony the prints were dated and placed in the cabinet for future reference as to their permanency. He expressed his belief that they would not change.

Mr. D. Chapman said he had, in his solar printing produced the best results by using old solutions of hyposulphite of soda for fixing; and he usually added a portion of old solution whenever he prepared a new fixing bath.

Mr. Anthony observed that he had also used air-slaked lime, which combining with a portion of the sulphur formed sulphate of lime, a compound which is insoluble in water, rendering the bath, in its working quality, very similar to the one before described.

The chairman suggested the use of chloride of baryta.

On motion of Professor Tillman, a committee consisting of Messrs. Newton, Joy and Anthony, was appointed to make further experiments with Mr. Anthony's fixing solutions.

Mr. William Kurtz exhibited a series of very fine silver prints, illustrative of various methods which he had adopted in lighting sitters at his studio; also very fine effects which he had produced by unusual manipulation in the printing process. He also exhibited several prints very beautifully finished in ink on albumen paper, and others from retouched and plain negatives, which, with the interesting description of his method of working, attracted marked attention.

Professor Joy suggested the propriety of some action on the part of the section in relation to the recent death, during the vacation, of Professor Schönbein, the discoverer of gun cotton. To him all photographers were deeply indebted for the great progress which had been made in the art within the last few years. His devotion to science and his genial nature endearing him to all, and the intimate relation which his discovery had to the photographic world, made it especially appropriate that his family should be remembered and apprised of the deep sympathy which the photographical section of the American Institute feel for the great loss which they have sustained.

On motion of Professor Tillman, the section unanimously voted, that the chairman be and hereby is requested to prepare and transmit to the family of Prof. Schönbein, a letter of condolence, expressive of the sense of the section in the loss of one so eminent, and whose labors were so intimately connected with those of the photographic profession.

Professor S. D. Tillman spoke of the success which had attended the efforts of European scientists to procure photographs of the late solar eclipse. It was unusual to find such interest manifested over a single astronomical event. English, French and German expeditions had been fitted out with all the necessary apparatus, and, after traveling thousands of miles, were stationed at different points along the line of total eclipse. The German observers were at Aden in Arabia, and the French and English much further eastward. One of the

advantages of this arrangement was the securing of pictures of the eclipse taken at different times, on close examination, will show whether there is within the space of about one hour any perceptible change in the form of the protuberances which extend beyond the moon's shadow. No particulars regarding the operations of the French and British expeditions have yet been received on this side of the Atlantic. By telegraph we learn that the spectroscopic observations have satisfactorily proved that the violet colored emanations are of gaseous origin. So little is known, with certainty, concerning the actual constitution of the sun, no opportunity for extending our knowledge in that direction should be neglected; the speaker, therefore, suggested that the next solar eclipse, which would be visible in this country on the 7th of August, 1869, should be photographed at as many different points as possible. The path of central band total eclipse, about 100 miles in width, will pass through Alaska, lat. 61° 46.9′ north, long. 68° 4.6′ west of Washington, on Saturday noon; crossing British America, it will again reach the U. S. territory near the head of Milk river, long. 30° west, pass through the southwest corner of Minnesota, crossing the Mississippi river near Burlington, Iowa, the State of Illinois just north of Springfield, and the Ohio river near Louisville. From thence it will run, in a southeasterly direction, through the States of Kentucky and North Carolina, and reach the Atlantic ocean near Beauford, North Carolina, at about sunset. North and south of this line the eclipse will be partial throughout the United States.

Here is a rare opportunity offered to all photographers, who have access to a telescope, to add important contributions to science. We should make early arrangements to bring every telescope into use on that occasion; hence it seems fit now to offer the following resolution:

Resolved, That photographers throughout the United States be earnestly invited to co-operate with astronomers in taking pictures of the solar eclipse, which will occur on Saturday afternoon, August 7th, 1869.

The resolution was unanimously adopted.

Adjourned.

November 10th, 1868.

Mr. Henry T. Anthony in the chair. Mr. Oscar G. Mason, Secretary.

The chairman introduced Mr. Thomas Garfield, of Boston, Mass., who gave a very interesting account of his researches on the effects of sunlight on glass, during the last five years. His remarks were very fully illustrated by specimens of glass used in his experiments, and a great number of most carefully finished photographic impressions obtained by the exposure of sensitized paper under such specimens, so arranged as to plainly show the changes produced by sunlight. In some samples of glass exhibited, the change produced by an exposure to sunlight during only one day was quite perceptible; others showing the effects of months and years of similar exposure. Some samples exhibited had been exposed for a period of seventy-five years.

With one or two exceptions only, Mr. Garfield had found that all kinds of glass are, more or less, effected by exposure to direct sunlight. He found that the great majority had a tendency to change toward the non-actinic shades of green and yellow, while some samples were much inclined to violet and purple. His experiments had, in the main, been confined to plate and sheet window glass. The few samples of optical glass used had exhibited quite a similar tendency to change. His systematic and carefully recorded observations elicited the praise of all present.

Mr. A. J. Drummond exhibited a series of twelve prints on Swan's pigmented tissue, illustrating his method of working the same, and the various tones which could be produced by the carbon process.

Mr. Kurtz exhibited further samples of the beautiful results which he obtains by a careful, artistic use of light in his studio.

The section then adjourned to the first Tuesday in December.

December 1st, 1868.

Vice-President Joy in the chair. Oscar G. Mason, Secretary.

Mr. C. W. Hull exhibited a number of mezzotint photographs by Carl Mienerth, of Newburyport, Massachusetts, which called forth a general discussion upon the use of the same or similar devices for the production of like effects. One firm had sent samples of such work from Philadelphia to Europe several years ago.

The chairman exhibited a large album containing very fine photographs of the leading scientific men of Europe and America.

Mr. Anthony exhibited stereoscopic prints which had been washed in water acidified by the addition of thirty drops of acetic acid to the quart. The prints were very fine in tone.

Mr. Anthony described the peculiarities of the "rapid rectilinear lens" recently produced by Mr. Dallmyer, of London, England.

Upon inquiry from the chairman, several members took part in a discussion upon the use of artificial light for photographic purposes; most of the members present believed that such light could not be used to advantage in ordinary practice, unless some material change was made in the mode of application.

Mr. H. J. Newton exhibited a transferred negative film, produced by Mr. Alfred Beach. The transfer was effected by flowing the image with a twenty grain solution of gum arabic, and after thoroughly drying, the negative was flowed with a plain collodion, and after again drying, the film was cut through around the edge of the plate and floated off in water.

Mr. Anthony stated that prints upon carbon tissue, transferred to a collodion film, were becoming quite popular as transparencies for window decorations in Paris.

Mr. A. J. Drummond, suggested coloring the print before the transfer, by coating the positive with a remotive colored gelatinous compound, then exposing to light, and washing the unaltered portions away. Such prints have a fine effect by both reflected and transmitted light.

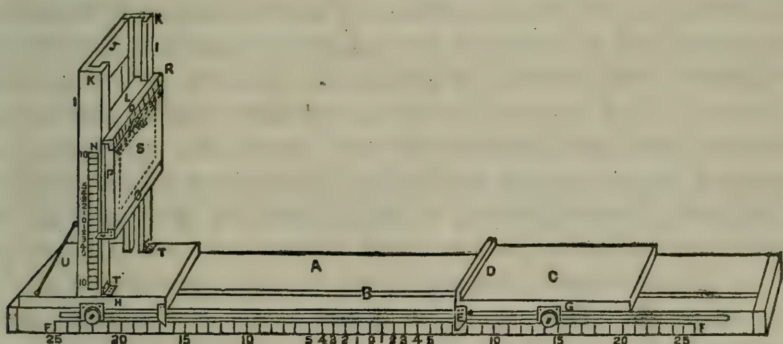
Mr. O. G. Mason, the Secretary, read the following paper:

Mason's Method of Copying.

All photographers who have occasion to copy daguerreotypes, ambrotypes, photographs, paintings, engravings, or other objects occupying a flat field, are well aware that several conditions are requisite for a first class reproduction by the camera, which do not exist, or may with apparent impunity be disregarded in ordinary portrait or landscape work. And yet we look through our best photographic establishments, and wade through the voluminous photographic publications of our own and foreign countries, without finding any systematic, simple, and efficient method by which uniformly good results may be obtained through inexpensive means, by those possessing but ordinary capacity. The wealthy amateur or

the organized company of capitalists may well afford nicely adjusted and exquisitely working instruments, which are far beyond the reach, or even the hope of many, in whose catalogue of expenses the necessary, and often perplexing items connected with the cost of living, must be first and greatest.

'During the last few months I have received several letters of inquiry as to the best method of copying pictures and other objects occupying a flat field. Several of these letters have thus far remained unanswered, save by a simple acknowledgment of their receipt and a promise of further attention at some future time; and I do not know that they can be better answered than *through* the photographical section of the Institute, and *by* a descriptive sketch of the device which I have had in use several years, on ordinary work, and in fact upon several occasions where adjustments to the $\frac{1}{100}$ of an inch were required, a nicety far beyond which the apparatus is quite efficient when properly constructed. It will be readily understood from the sketch and following description:



A is a plain smooth board of any desired length and breadth, having a cleat at each end, to prevent warping or splitting, and having a groove, B, plowed in its upper surface, along which the tongue-guide of the sliding board or camera truck, C, can easily move and thus be kept parallel with the base, A. Upon this truck, C, which rests upon four small wheels, one under each corner (but not shown in the figure), the camera is placed with its front resting against the ledge, D, in which position it may be clasped by a set-screw, though I do not find it necessary to do so. The board or truck, C, may then be made to travel with its load, the camera, forward or back to any desired point; and its position will be indicated by the index, E, moving over the scale, F, which is divided into tenths and hundredths

of an inch; or a vernier scale may be substituted for the index when greater nicety is required. Any desired position of C may be obtained by the set-screw, G, the head of which runs in a rabbeted groove in the edge of the base board, A.

H, the truck for the plan-board is provided with a guide index and a set-screw as in the case, C.

Upon this truck are erected two uprights or posts, I, joined at the top and made firm by the cross-bar, J. These posts, as shown at K, are grooved, in which the tongues of the strong frame, L, have a free perpendicular motion; holding it at any desired point, indicated by the index, M, on the scale, N, by a set-screw on the back side, and not shown in the diagram.

Upon the frame, L, are fastened two guides, O, in which the plan-board P, has a free horizontal motion, its position being indicated by the index, Q, upon the scrole, R. The center, S, of the plan-board, as shown by the dotted line, may be removed at pleasure by turning two small buttons, so arranged as to be flush with the back, and offering no obstacle to the proper motions. When the portion, S, is removed a negative may be inserted in its place, and the apparatus is excellently adapted to the production of glass positives, and is so used by me in preference to a far more expensive apparatus which I constructed several years ago expressly for such work. For convenience of packing, laying away on the shelf, or hanging on a nail in the operating room, the uprights may be hinged as shown at T, allowing the plan-board, when not in use, to fall forward, and lay flat upon the base, A; and when in use may be held in position by hook braces as shown at U. The one which I use in my own practice is so constructed.

With this simple and cheap apparatus, many perplexities may be avoided, and much time saved. The operator is always sure that the plane of his original on the plan-board is at a true right angle with the axis of his copying lens. The vertical or lateral position of the original may be easily changed without interfering with the focus or removal from the plan-board.

Whenever a copy of any special size is made, either equal, reduced, or enlarged, and the positions of the several parts of the plan-board and camera are noted, no further focusing upon the ground glass is ever needed for reproductions upon that scale and by that lens. Of course it is necessary to observe the position occupied by the ground glass, for any given scale of enlargement, or reduction. A paper

scale may be pasted on the base or bottom frame of the camera and a simple index attached to the sliding portion of the camera body. Any one will understand the necessity of having the surface of all subsequent originals occupy the same relative position as those used in establishing the various scales of the plate or paper of any original are thicker or thinner, the truck of the plan-board must be moved backward or forward, as the case may be, until the proper compensation is indicated by the index on the scale, F.

For example, the operator has occasion to make a copy upon a scale of four times the original, which, for convenience, he places upon, nearly as may be, the center of his plan-board; this center is shown by the intersection of two right angle lines drawn through the extreme length and breadth of the plan-board, as is often done on the ground glass of the camera. Having placed his camera on the truck, C, he proceeds to adjust the focus and size for his copy upon the ground glass, by the necessary movements of the several parts. After the negative is produced, and found to be of the required size and satisfactory definition, he notes the position of the indexes on the several scales, and afterward he is sure of correct focus and size (for that scale) by referring to his note book or sheet of scales and fulfilling the conditions there recorded.

A list of scales for reduction, and another for enlargements may thus be made, with good subjects and light, which by frequent use are retained in the memory, so that even reference to the recorded scales soon becomes unnecessary; and the ground glass of the camera box has but little use, except to exclude the dust from the interior. In dull weather, the eyes of the operator are relieved from the perplexing, and sometimes vain search for the best focus, and much delicate work may be intrusted to an assistant, who would be most likely to produce unsatisfactory results by the ordinary methods. To those unacquainted with systematic work, the use of such an apparatus may, at first sight, appear troublesome, but it is really so simple that any one may in practice learn its use in much less time than is required to read this description. In fact the whole thing can be comprehended at a glance.

After some discussion on the merits of this apparatus the meeting adjourned.

January 5th, 1869.

Vice-President Joy in the chair. Oscar G. Mason, Secretary.

New Camera Box and Stand.

Mr. C. W. Hull exhibited a well finished camera box invented by Mr. Fleming and manufactured by the American Optical Company.

The box was so constructed as to allow a spherical motion of the lens through an arc of thirty degrees, the central point being the surface of the sensitised plate and the motion producing no change of focus when using a lens of about eleven inches focus; for which the box was constructed. The motions were fully explained by Mr. Hull and their advantages highly spoken of by several members.

A very substantial tripod prism shaft and tilting table camera stand was exhibited, from the works of the same company. The elevation and depression of the shaft was easily and quickly accomplished by means of a serpent screw, which was worked by a small crank on the body of the stand or case which enclosed the shaft.

The table or cap on which the camera was placed could be raised or depressed at either front or back, and held at any desired angle with the horizon by a similar device.

New Posing Rest.

Mr. Charles E. Krüger exhibited a novel and ingenious posing rest so constructed as to sustain the modle in a great variety of positions. Its merits were illustrated by a series of photographs and explanations by Mr. Chapman.

New Photographic Outfit.

Mr. H. T. Anthony exhibited a miniature dry plate photographic outfit consisting of camera box and lens, focusing lens, ground glass, shields for six plates three and a quarter inches square, and a tripod stand which folded into the form of a cane, the whole weighing about three pounds, and could be furnished at a cost of about sixty dollars. The apparatus was manufactured by Messrs. Negretta & Zambra, of London, England. Mr. Anthony also exhibited a series of very fine silver points made by Mr. W. J. Baker, of Buffalo, N. Y. The effects of lighting and apparently neat, careful manipulation of chemicals were highly praised by those present.

Mr. Thomas Garfield, of Boston, Mass., presented to the section two silver prints, negative and positive, showing the effects

of actinic light transmitted through autumn-tinted leaves; also, a print by a novel method of producing a portrait. By paper cut in the form of a stencil, the actinic light was obstructed in the lights and admitted through openings in the sheet, for the dark parts of the picture. The section passed a vote of thanks to Mr. Garfield for his contribution to its collection.

Professor Joy exhibited a series of lithographed stereoscopic slides for studies of the form and lustre of crystals. He also read extracts from a letter which he had recently received from Professor Tyndall, of London, England, communicating the results of some experiments upon which he had been engaged, with a view of determining the conditions attending changes in the tint of the atmosphere in various localities and at various altitudes.

Mr. John Johnson of Saco, Maine, described a solar camera, which he had some years ago erected in the State of Maine. The tint of the sky, as shown upon the ground glass focusing screen, was often very peculiar.

Prof. S. D. Tillman presented, for Edward L. Wilson, Esq., of Philadelphia, a copy of *The American Carbon Manual*, for which a vote of thanks was tendered to Mr. Wilson.

Mr. W. Kurtz exhibited several very beautiful prints, in further illustration of his methods of lighting his sitters.

Mr. Krüger exhibited a number of single figure and group prints with landscape surroundings, which evinced skill and ingenuity in the use of material, enabling him to produce charming effects in the gallery, which, with his fine chemical manipulation, was much admired.

On motion of Mr. C. Wager Hull, a resolution was passed requesting every member of the section who is a *practical* photographer, to donate one photograph to the section at each meeting, and that three members be appointed as curators to take charge of such donations and arrange them in the cabinet. The chairman appointed as such curators, Messrs. Anthony, Mason and Hull.

On motion, a resolution was passed requesting the American Institute to furnish the necessary frames, cases, etc., for the preservation of this collection, and space for the convenient and proper exhibition of the same.

The section then adjourned.

February 2d, 1869.

Mr. Henry T. Anthony in the chair. Oscar G. Mason, Secretary.

Minutes of the last meeting were read and approved.

Mr. Hull exhibited a set comprising about thirty of the so-called "prize pictures," proposed for the "Philadelphia photographer." He also exhibited a print from a negative made with the camera box, invented by Mr. Fleming, and shown at the last meeting of the section, and he remarked that he could not have produced the negative with any other camera box with which he was acquainted. He also exhibited a well constructed camera and changing box for plates five by eight inches, and so arranged as to work plates of various other sizes; also several negatives made by one of Dallmyre's new rapid rectelinier lenses, with an exposure of five seconds, also instantaneous. The lens with which the negatives were made was also shown.

The chairman introduced Captain Russel, the official photographer of the Pacific Railroad Co., who exhibited a series of very interesting photographs made during a recent tour over the route. The prints were from plates 10x13 inches. The strange scenery of the far west and the careful manipulation under adverse circumstances, which they illustrated, were highly creditable to the artist, and elicited much praise.

Captain Russel related several anecdotes of mormon life as he saw while photographing in Utah.

Mr. Newton read the following paper, and exhibited several interesting stereographic plates, illustrative of the various processes with which he had experimented, as detailed in his paper.

Photographic Experiments by H. J. Newton.

In dry plate processes, very little is known positively, as to the exact ingredient, in a solution that acts upon the sensitive film to preserve it, consequently experiments have a wide field from which to gather their material for experimenting. For example, there is not enough known upon the subject to enable us to foretell what effect tea or coffee would have upon the plate without trying it, or what would be the effect of a multitude of other vegetable substances. It seems proper, therefore, in giving some results of experiments, to state in full the failures as well as those results which are deemed successful. The tannin plate has usually been recognized as the standard by experimenters, as it was the first really good and successful

dry plate. Experiments have not been made with a view of finding something which would keep a plate longer than tannin, but to find something which was as good a preservative as tannin, and at the same time possessed qualities which would enable it to retain its sensitiveness. A number of experimenters claim to have succeeded in producing such plates. I have tried almost every published formula, and I have no hesitation in saying, that there are a large number of formulas which will, if carefully worked, produce plates superior in every respect, to tannin plates.

The keeping qualities, of course, can only be decided by time; it is a fair inference, however, that if a plate will keep through the summer months without suffering any detrimental change, that it is good for a year. The coffee plates have been kept two years without showing any change, which is much longer, under ordinary circumstances, than would ever be required. After a plate has kept well for a year, the fact that it will keep another year adds nothing to its value. As I have previously observed, the object of those experimenting with dry plates has been to discover something that would make them approximate as near as possible in their sensitiveness to wet ones. The great drawback to the tannin plates has been their lack of sensitiveness. About a year since, the use of the acetate of morphia was introduced as a preservative, but it proved to be only a sensitiver, and without any of the qualities requisite for a preservative. Plates prepared with it were very nearly as sensitive as wet ones, but they kept no longer, if they did as long, than when they were simply washed. I tried it also for paper negatives with the same results. The idea came to me, that by combining the acetate of morphia with tannin, I might retain the sensitive qualities of the morphia, and the keeping qualities of the tannin. I made a few plates, and kept them several weeks; they showed no signs of change, and were as sensitive as those prepared with morphia only; and I exhibited some negatives made on those plates to this society, which were exposed thirty seconds according to my recollection. I found, however, in a short time that there was a lack of harmony in the solution; it had undergone a change which rendered it unfit for use as a preservative. I then made a compound of opium, sugar of milk and tannin, calculating to get the morphia of the opium in a form that would not be as susceptible to change. After a few trials, I ascertained that the following proportions answered my purpose, not only making a very clear and brilliant solution, but one that will

keep indefinitely. I have some now on hand, made nearly eight months ago, which has undergone no perceptible change. I use hot water, six ounces; finely pulverized sugar of milk, quarter of an ounce; tannin, forty grains; tincture of opium, one half drachm; put together in the order here given. The sugar of milk dissolves very slowly, unless pulverized and placed in hot water. The addition of the opium causes a precipitate in the solution, and it should stand at least twenty or thirty minutes before it is filtered. I prefer sugar of milk to any other saccharine substance, because, unlike all others, it is not liable to alcoholic fermentation, which always precedes putrescence or the generation of putric acid, in saccharine solutions. With plates prepared by this preservative, I have made negatives in the month of June, using four and a half inch focus lenses and a quarter inch diaphragm, in five and six seconds, with the alkaline developer, which was quite as quick as I could make them with wet plates. I also prepared some plates with a modified coffee process, the only material difference being the substitution of sugar of milk, twenty grains to the ounce, for the loaf sugar usually prescribed. This solution keeps, and can be used, for months without exhibiting any symptoms of change. The sugar of milk forms a very hard and dry varnish on the surface of the sensitized film; and another office which it appears to perform, is to render the negative soft and harmonious, preventing violent contrasts. That the sugar of milk has this tendency, I proved by making some dry plates preserved with sugar of milk alone. Coffee plates prepared by this formula are very sensitive, but not quite as sensitive as those by the preceding process; they keep, however, equally well, and in this respect, as also in the quality of the negative, are all that can be reasonably desired. The process is simple and efficient.

I have succeeded in perfecting a tea process which is reliable, and in most respects, produces results similar to the coffee. I experimented with several samples of Oolong tea, with different results in almost every instance. I then procured some Japanese tea, and the plates resulting from its use were very fine. I have since experimented with different samples, and the results have been uniformly the same. I make a strong tea, using a large spoonful, which I put into a bowl and pour on eight or ten ounces of boiling water, then cover it over, and keep it hot for about an hour, then make it up to ten or twelve ounces; add, while hot, fifteen to twenty grains to the ounce of finely pulverized sugar of milk, filter, and as soon as cool, it is

ready for use. I exhibited some plates preserved with this process to the members of the photographic society at one of our meetings last fall, at which Mr. Rockwood was present. He stated that he had used tea for preserving dry plates, and at times produced very fine results, but he had used Oolong tea, and he often found his plates bad where there had been no change except in the tea. If I recollect right, he stated that he published some of his experiments; but, as far as I was concerned, I had no recollection of ever seeing any published process for using tea for a preservative. I have used, in experimenting, loaf-sugar and also rock-candy in these solutions, but prefer and would recommend sugar of milk. I made a very sensitive plate by adding a grain and a half to the ounce of acetate of morphia to my tea solution; it worked in one-fourth of the time; whether they will keep I am unable to say. I have one, however, which is several months old, that will test that point when used. There was one drawback, however, to its adoption; the same difficulty presented itself that appeared in the tannin, into which I introduced acetate of morphia; the tea soon became turbid and unfit for use, except, perhaps, as an anodyne. Whether the morphia could not be introduced into these other solutions, in the same way adopted with the tannin, with the same or still more beneficial results, I have not yet had an opportunity to demonstrate. Since the publication in the *Philadelphia Photographer*, of Mr. Carey Lea's modified Gordon's gum process, where he claims to have produced dry plates with his bromide of silver collodion, as sensitive as wet ones, I have applied this gum formula to dry plates made in the ordinary way; the only change from Gordon's is the substitution of twelve grains to the ounce of sugar instead of five, with the addition of carbolic acid to preserve it. In my experiments last summer with Gordon's process, I used two drops of the solution of carbolic acid to five ounces of the gum solution, to prevent its changing. With this new gum formula I have produced very sensitive plates, requiring from thirty to forty-five seconds exposure with an iron developer; according to my recollection, that was the time I found necessary for the old formula. Those experiments, however, were made in midsummer, which would show increased sensitiveness by the new formula of at least one-third. I have made very beautiful dry plates, about one-quarter more sensitive than the tannin plate, with a strong tea made with white oak bark. I have also used, as a preservative, bisulphate of quinine, peruvian bark, quassia, rhubarb root, sumach leaves, with

varying results. It had become quite a common remark, that it was more difficult to find things which would not preserve dry plates than to find things which would. I have experienced no difficulty of that kind.

The effect of Croton water on the sensitive film may be of interest to those New Yorkers who are trying to make dry plates. There are three months in the year in which it can be used without any injurious results; from the first of January to the first of April, and, if the season is cold and backward, to the first of May. As soon, however, as the weather becomes sufficiently warm to cause the decomposition of vegetable matter to commence, you will, if you observe closely, notice a change in the sensitiveness of your plate, which cannot be attributed altogether to the change in the season, and this goes gradually on until something appears which will strongly remind you of fogging; and yet you will be hardly able to define it as such, the sensitiveness still increasing as this tendency to fog increases. This went on with my experiments last summer, until the middle of June, when the fog became decided, and, before the first of July, it had become a dirty veil. The negatives produced before the middle of June were good printing negatives, notwithstanding the tendency to fog. After this time until cold weather has prevented decomposition, and the old stock of water on hand has run off, and been replaced by that which contains comparatively no organic matter, Croton water is worthless for washing dry plates, for the first or second washing at least, from May to January.

I mentioned to Mr. H. T. Anthony the facts here stated, knowing that he had had much experience with dry plates. He stated that his experience had been similar, and that he attributed the effect observed to animal matter more than to vegetable. He stated that, in the month of June, the Croton water became saturated with fish-spawn to such a degree that it clogged the sieves in some places, so that it became necessary to remove it once in twenty-four hours. It would appear from this, that a certain quantity of animal or organic matter in the water will give increased sensitiveness to the film, and it becomes a delicate question to determine just the kind and quantity to a given amount of pure water, to arrive at the extreme point of sensitiveness without fogging. All who have ever produced dry plates, agree that one of the most important parts of the process is the washings, and that the employment of pure water for the first washing is absolutely necessary. I obtain the water which I use by

melting ice; it can always be depended upon, whereas, distilled water, usually obtained at the druggists, frequently contains impurities which render it unfit for washing a sensitized collodion film.

I have experimented much with different developers, and have been thoroughly converted to the doctrine of those advocating strong developers. I have always found that a developer, at least twice as strong as usually recommended, used with not more than one-half the nitrate of silver commonly used, produces much finer results, beside lessening the time of exposure one-half. Negatives developed with a strong developer and the smallest trace of silver, are always soft and full of detail. For a stereoscopic negative, two drops of a ten-grain solution of nitrate of silver are sufficient.

I have succeeded in compounding an iron developer which works well, and the exposure of the plate is reduced about to the same time required when the alkaline developer is used, and the results are as good in every respect; it has the advantage of being much more simple. It is prepared as follows:

Gelatine	20	grains.
Double sulphate of iron and ammonia	80	"
Sulphate of iron	80	"

Soak the gelatine in cold water fifteen minutes; then put the above together in a bowl with the gelatine, and pour on boiling water, ten ounces. When the gelatine and iron have dissolved, add ten drops of concentrated ammonia and shake thoroughly; then add sufficient glacial acetic acid to dissolve the precipitate, which will be about one drachm; then add twenty grains of tartaric acid. This developer works the best after it is two weeks old. For a plain pyro acid developer, use eight or ten grains to the ounce of water, and four or five grains to the ounce of citric acid. I have, however, used a developer made as follows, which is very energetic, and produces beutiful, wine-colored negatives with very short exposure:

Hot water	5	ounces.
Gallic acid	30	grains.
Pyrogallic acid	30	"
Citric acid	30	"
Glacial acetic acid	30	drops.
Saturated solution of acetate of lead	10	"

The glacial acetic acid dissolves the precipitate formed by the addition of the acetate of lead.* Unless hot water is used, the gallic

* The addition of acetate of lead to a gallic acid developer to increase its developing power, should be credited to Mr. Carey Lea.

acid will dissolve very slow, as that amount is a saturated solution in cold water.

Mr. H. T. Anthony exhibited two prints from dry plate negatives by the coffee process; subject, "Home of Washington Irving."

Mr. H. J. Newton presented an enlarged print $6^2 \times 8^2$ inches from one of his stereoscopic negatives of the bow bridge in Central Park.

Mr. C. W. Hull described the construction of his small chemical or dark room in which he dries his tannin plates, and avoids the peculiar ring-like markings which are so often found in drying.

Mr. H. J. Newton described the construction of a gas stove which he uses with uniform success in the preparation of dry plates.

Mr. A. J. Drumond described a method of drying carbon tissue by the use of sulphuric acid in apparatus recommended by Mr. John W. Osborne.

Mr. J. B. Gardner presented three card prints, showing good effects produced by collodion which did not contain bromine.

Mr. O. G. Mason presented two stereographs of polypus of the human heart, photographed in the jar of preservative fluid as prepared for the Bellevue Hospital Museum.

Captain Russell presented several of his Pacific rail road views for which he received the unanimous thanks of the section.

Mr. John Johnson exhibited a reflecting camera as used by daguerreotypists in the early days of the art. The camera was constructed by Mr. A. S. Wolcot in the year 1842.

The section then adjourned.

March 2, 1869.

Mr. John Johnson, of Maine, in the chair. Oscar G. Mason, Secretary.

Mr. H. J. Newton gave some further details of his experiments with alkaline negative baths, and exhibited a collection of prints which were made from negatives taken by an ordinary window at his residence. The prints gave substantial proof of the fine working quality of the alkaline process.

Mr. J. W. Kuhns presented for Mr. S. M. Fassit, of Chicago, Ill., a very fine 10×12 photograph, in the style introduced by Mr. Adam Solomon, of Paris. The print was much admired.

New Filter.

Mr. D. H. Houston exhibited and explained a very simple and efficient filter which he had so constructed as to give the liquid an

upward flow and guide the filtered stream to a definite point below by the elongation of one side of the discharge tube.

Mr. C. W. Hull exhibited and explained the action of an inverted filter invented by Mr. V. M. Griswold. He also exhibited a series of very fine photographs made by Mr. Krügher.

Mr. John B. Gardner called attention to the difficulty of mounting prints on lithographed tints.

Mr. H. T. Anthony suggested the use of some weak alkali to counteract the greasy effect of the lithographic ink.

Mr. D. C. Chapman stated that he had found it advantageous to use a small quantity of aqua ammonia in the starch with which he mounted prints. It prevents fermentation and increases its adhesive property.

Mr. J. B. Gardner exhibited a negative on which a portion of the varnish had exfoliated. Several members spoke of their experience in like instances, and they believed that the peculiar effect was produced by moisture on the plate or in the film of collodion. It was also suggested that it might be the result of something in the composition of the glass.

Mr. W. Kurtz exhibited several very fine imperial photographs; also, an enameled photograph on porcelain, bearing date February, 1869. He explained his method of producing the result, which he hoped to further illustrate at a future meeting. He also presented three imperial card photographs for the cabinet.

Mr. C. W. Hull spoke of the great utility of a process like that of Mr. Kurtz.

Mr. O. G. Mason spoke of its adaptability to the decoration of dishes for the dining table, with family portraits and historic scenes.

Spirit Photographs.

Mr. Mason also gave an account of a recent visit which he had made to the establishment of one Mumbler, who claims the wonderful power of commanding the presence of disembodied spirits, and therefrom producing a picture in connection with that of a sitter in the corporeal form. Mr. Mason exhibited several of the so-called spirit photographs, in which the same spiritual individual had personated the departed relative of several persons who were unable to trace any other bond of consanguinity. In one case the so-called spirit, a grandmother who had so kindly appeared at the summons of Mumbler, was proved to yet inhabit flesh and blood, in the form of a somewhat ancient lady, who emphatically denied ever having

been the mother or grandmother of any one. Mr. Mason concluded his remarks by expressing a hope that the police authorities would visit this mysterious photographer, and teach him that this business of "spirit photography" was a punishable crime, when used for gain, like other methods of procuring money by false pretences. Then followed a general discussion, in which several members spoke of the various methods by which they could produce similar results.

Mr. Geo. H. Weeks read a short paper on the production of so-called spirit photographs. He also exhibited a plate upon which were several images, obtained by the use of nine lenses and a reflector.

Mr. D. C. Chapman exhibited prints produced by first transmitting the light through colored glass of various tints, which called up some discussion upon the actinic force of light, when so transmitted through colored media.

Mr. John Johnson followed with some remarks on the properties of light when transmitted through glass, as shown by a long series of experiments which he made, some years ago, on the germination of seeds under the influence of different colored rays.

Mr. H. T. Anthony presented to the section a fine quarto album for 200 photographs of members of the section, for which a unanimous vote of thanks was tendered.

The section then adjourned.

April 6, 1869.

Professor S. D. Tillman, in the chair. Oscar G. Mason, Secretary.

Mr. E. Blunt, Jr., exhibited a series of imperial card photographs to illustrate the working quality of his "one-third" portrait lenses.

Mr. O. G. Mason presented two stereographs of a skull, showing the reformation of the lower jaw after removal by surgical operation.

Mr. H. T. Anthony exhibited a photographic lens once owned by the late M. Daguerre, of France, the inventor of the daguerreotype.

Mr. H. T. Anthony called attention to the method of carbon printing process invented by Herr Albert, the royal photographer of Bavaria. The printing matrix was composed of a layer of gelatin, albumen and bichromate of potash on glass, and exposed to light transmitted through a photographic positive. Plates so made were said to be capable of giving several thousand impressions of uniform good quality. Several members entered into a discussion of the merits of the various methods for producing photographic prints in carbon.

Chemical Action of Light.

Prof. P. H. Vanderweyde read a paper upon the action of light in forming the image on a daguerreotype plate. He said the iodised silver plate being put in the exact place occupied by the ground glass used in ascertaining the focal point, receives the impression of the luminous image formed at that spot by the lens; the impression so received separates the combination of iodine and silver, setting the silver free, or, in a word, resolving the so-called iodide of silver which was formed in the dark, into its two constituent elements. This action of light, in separating compounds into their elements takes place also in the vegetable kingdom in regard to the carbonic acid gas contained in the atmosphere. It has been proved, in fact, that the leaves of plants absorb this carbonic acid in the same manner as the lungs of animals absorb the oxygen, for which reason leaves have been called the lungs of the plants. It has also been proved that, under the influence of sunlight or daylight, this so absorbed carbonic acid is decomposed in the leaves, the oxygen escaping in its gaseous form; while the carbon, taking on its natural solid form, is retained, and, in combination with water, is deposited in the plant as woody fibre. In a perfectly similar manner, in the process of daguerreotyping, the silver is set free in the metallic state by the influence of light in a degree proportionate to the intensity of the light acting on different parts of the film of iodide of silver.

When such a plate is left exposed in the camera obscura for a few hours, the image will finally appear on it by means of the silver reduced, which, after its separation from the iodine, will appear upon the surface of the iodized silver plate as a fine pulverulent substance, of a different aggregate condition from the silver not so reduced. The coating of iodide of silver must then be removed by some kind of solution, as otherwise the decomposition of the iodide of silver would continue every time that the plate was exposed to daylight, and the picture, consequently, would, in the end, entirely disappear. When, however, this sensitive coating is dissolved away, the plate has nothing on its surface but silver in different aggregate conditions, polished in the shadows, and pulverulent in the light; and the picture is permanently fixed.

This was the first process of Daguerre; but as it took too long an exposure in the camera, he attempted to shorten the time from hours to minutes; and had the good fortune to conceive that, in the short time of a few minutes, already a change must have taken place in the

iodide of silver film, which, notwithstanding it was invisible to the eye, might manifest itself when the plate was exposed to the influence of other substances. It was soon found that this silver, separated from the iodine by the influence of light, had obtained a great affinity for mercury, and, consequently, a strong tendency to combine with mercurial vapors not possessed by the iodide of silver when the vapors were not heated above 180 to 200 degrees Fahrenheit. This iodide of silver, then, not combining with those vapors, the consequence was that, when such a plate had been exposed to the luminous rays in the camera for a few minutes only, and on which nothing was yet visible, exposure to mercurial vapors of some 180 degrees Fahrenheit would not affect the silver plate wherever it was protected by the film of iodide of silver, but only where some silver of this film had been set free by the action of light. The amount of deposit of mercurial vapor was also found to be proportional to the amount of silver set free, which, again, was proportional to the previous intensity of the light acting on different parts of the plate.

The deposit of mercury, or rather amalgam of mercury and silver, thus formed on the surface of the protecting film of iodide of silver constituted the picture. A microscope, when of sufficient magnifying power, detects the amalgam to consist of minute globules, very close together in the high lights of the picture, less close in the less illuminated portion, very sparsely distributed in the shadows, and altogether absent in the blanks, which consisted of pure iodide of silver.

After the reading of Prof. Vanderweyde's paper, several members entered into an animated discussion upon the chemical and mechanical action of forces in the production of the photographic image.

Mr. Mertz related an interesting case in which he had produced a definite image of a solar eclipse on a collodion film without the use of any developing agent. The image was quite distinct when the plate was taken from the camera.

Mr. J. Johnson gave an account of some recent experiments on actinic light in photographic printing and the growth of plants.

Mr. H. T. Anthony remarked that he had found in an extensive photographic printing establishment, the amount of gold and silver remaining in the finished prints were about equal. This was determined by the treatment of the residues, and recovery of the metals.

The section then adjourned to the first Tuesday in May.

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